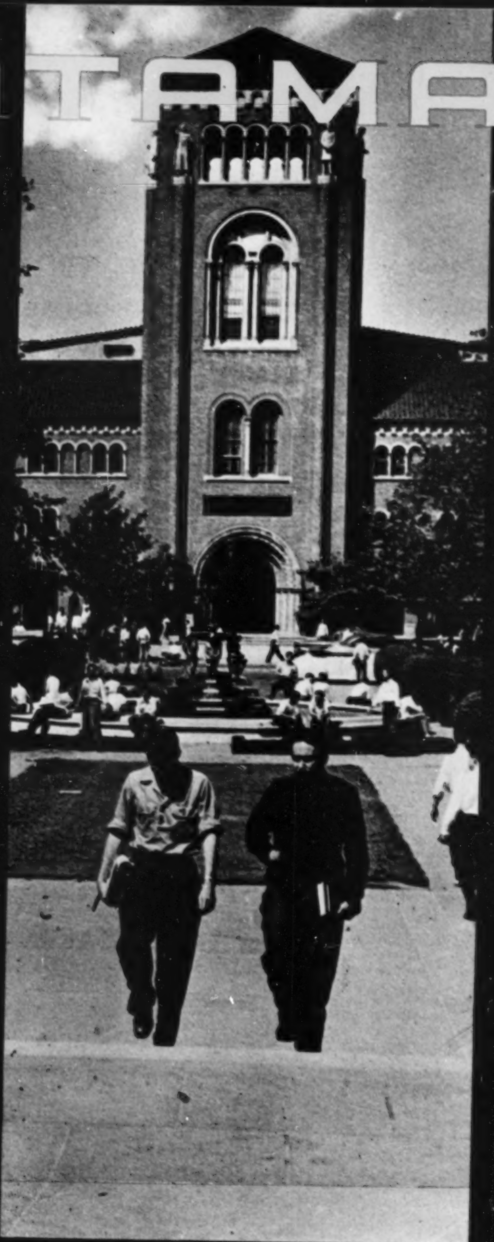
DATAMATION

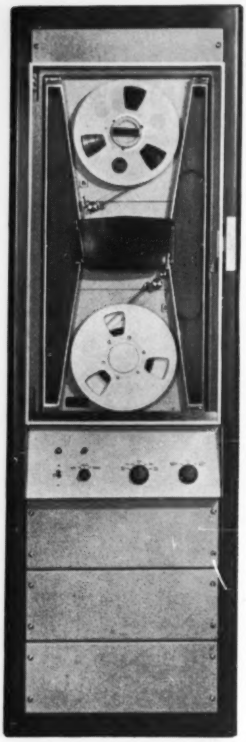
61

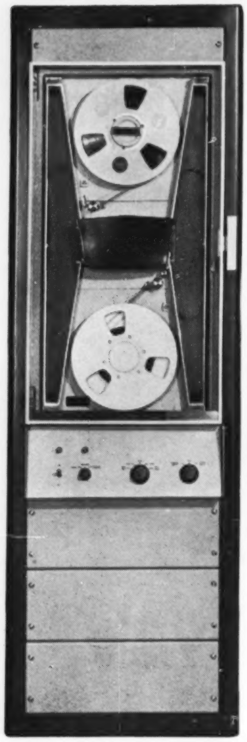
September

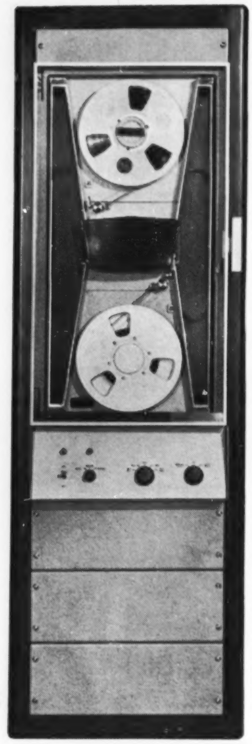


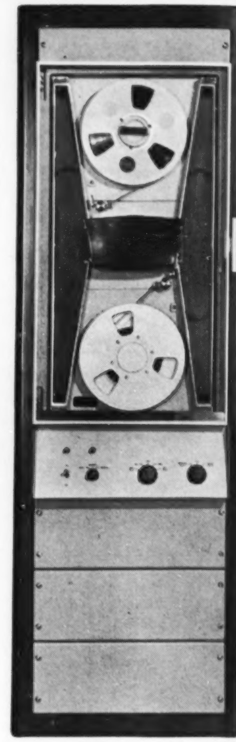
Syn'no-et'ics (sin'no-et'iks), n. (Gr. syn + noe to perceive together) The science treating of the properties of composite systems — consisting of configurations of persons, mechanisms, plant or animal organisms, and automats — whose main attribute is that their ability to invent, to create and to reason — their "mental" power — is usually greater than the "mental" power of their components.

Page 34









ON & ON & ON & ON

That's the way it goes ("it" being the Ampex TM-2 digital tape handler). On and on, with hardly a pause for maintenance. Completely new servo and tape guide systems give the TM-2 extremely long term performance stability. Improved vacuum buffer columns gently hold the tape supply and take-up loops. Specially developed inertia brakes give reliable stop times and short stop distances at high tape speeds. Start time of 2.0 ms and stop time of 1.5 ms are consistent under the most rigorous programs. And the TM-2 has a 90 Kilocycle character transfer rate. Why not send for all the facts: Ampex Computer Products Company, P.O. Box 329, Culver City, California.

AMPEX 0/1 T.M.

AMPEX COMPUTER PRODUCTS COMPANY

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AMPEX COMPUTER PRODUCTS COMPANY

CIRCLE 1 ON READER CARD

DATAMATION 61

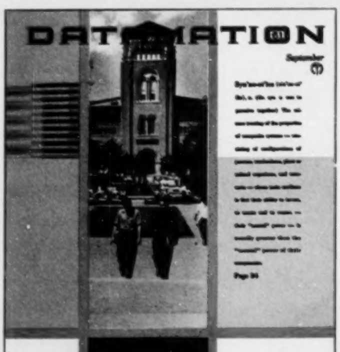
the automatic handling of information

volume 7, number 9

Articles

Departments

THIS ISSUE — 33,855 COPIES



Cover

"Computer Related Sciences (Synnoetics) At A University in 1975" is expounded with noteworthy precision by author Lou Fein beginning on page 34, and attractively synthesized for this month's cover design by art director Cleve Boutell.

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BPA

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NBP

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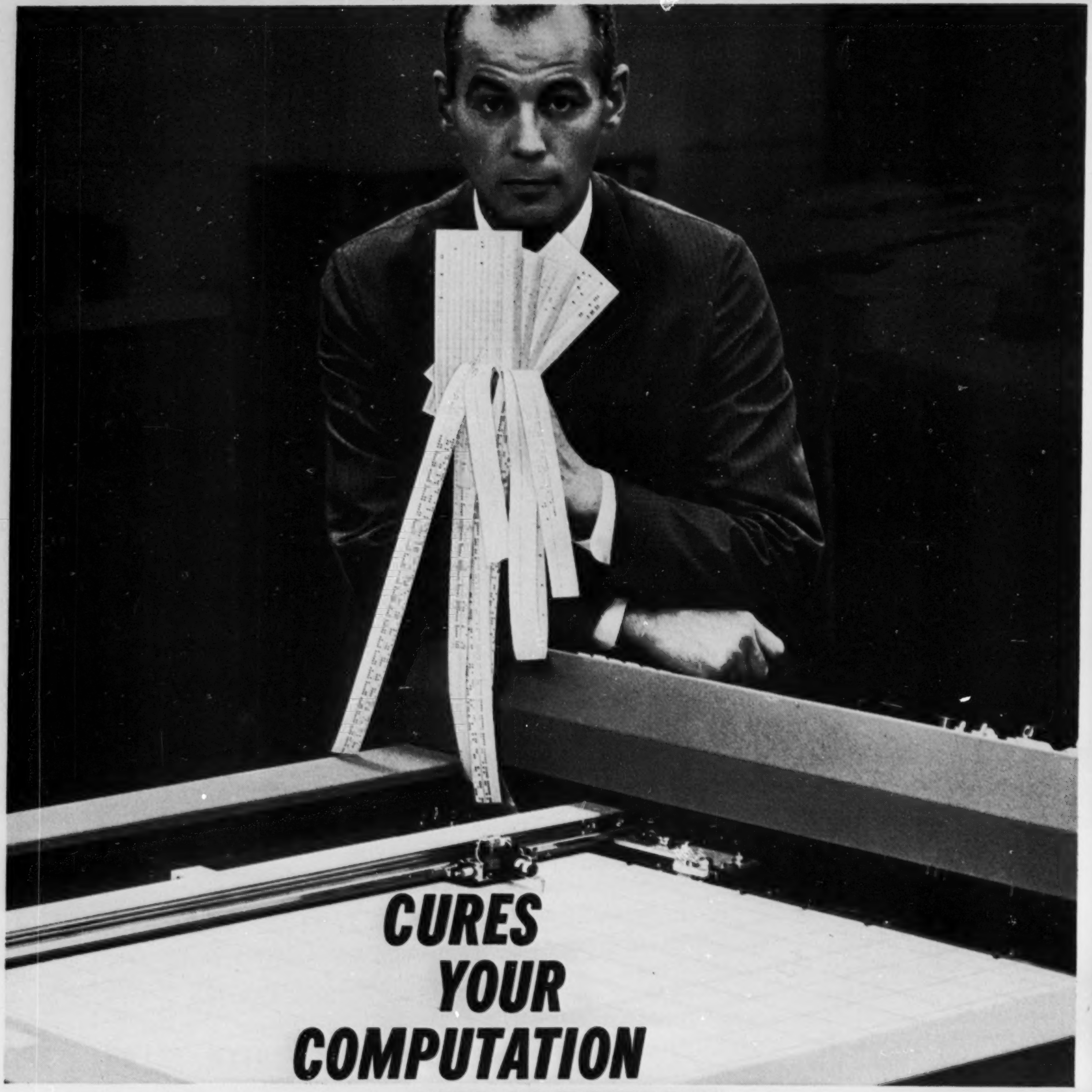

CURES YOUR COMPUTATION INDIGESTION

Here is how to reduce the overwhelmingly voluminous output of a digital computer to a useful form. You need a convenient, rapid and accurate way to plot curves and charts automatically and accurately — such as the EAI DATAPLOTTER 3300. This superb plotting machine reduces digital information to Cartesian coordinates in X and Y, in point or line, on paper size up to 30 x 30 inches. Plots up to 80 points a minute with accuracy of .05% of full scale. There are many accessories and a wide variety of other plotters if the 3300 does not fit your needs. Write for information to Dept. DA-9.

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Leader in Analogics   Analog/Digital Computers   Data Reduction   Process Control   Instruments   Computation Service

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at 2400 bits per second... over regular phone lines

A single computer can serve all points in a widespread organization —*directly*—with General Dynamics/Electronics High-Speed Data Transmission Systems. Data from a network of offices, plants, stations, warehouses or other points can be fed into the central computer over regular telephone lines... at 100 fully punched cards per minute, or at 350 seven-bit characters per second for magnetic tape. And results can be sent back... as they're processed... since either terminal can send or receive.

Accuracy? Highest yet, due to a special error detecting code and a unique method of *dual transmission*.

Possible combinations? Direct computer entry from tape or cards. Card to card. Tape to tape. Card to tape. Tape to card.

Other permutations utilize paper tape, buffer systems, or the General Dynamics/Electronics High-Speed Communications Printer ... which can print direct readout "hard" copy at 3500 words per minute from magnetic tape when used with this system.

Modularized, solid-state construction is used exclusively in all systems for utmost reliability, accuracy, low upkeep costs and minimal down time.

For more information about the business, scientific and military applications of General Dynamics/Electronics Data Transmission Systems write: Information Technology Division
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CIRCLE 6 ON READER CARD

GENERAL DYNAMICS | ELECTRONICS

CIRCLE 71 ON READER CARD

BUSINESS & SCIENCE

CEIR IN LA TAKES A GIANT STEP

In what may well prove to be the world's largest commercial installation of computing power, C-E-I-R on Wilshire Blvd. in Los Angeles has announced plans for a giant computing facility featuring a STRETCH, 7090, 1604, two 1401s, and a 160A.

Director of commercial sales William Crowley expects a local staff of more than 400 to sell time and operate the facility. This also marks the first occasion when C-E-I-R has ordered non-IBM machines; in this case, a CDC 1604 and 160A, attributed in part, to the earlier availability of CDC equipment over the 90's.

With the exception of STRETCH which is scheduled for delivery in the Fall of '62, all of the equipment should be on the air by January and hopefully, with sufficient business to occupy the more than ample amount of available time.

CDC's 924: UNANNOUNCED & AVAILABLE

A new entry from Control Data Corp., the 924, although unannounced, has been produced and installed in duplicate at Lockheed's Sunnyvale facility. One reason for the delay in announcement may be attributed to CDC's evaluation of the 924 as its first bid for the business market. It's a slower, shorter word length version of the 1604 at a considerable price reduction.

The 924 has a 24 bit word size (48 bits in the 1604) with an add time of 9.3 microseconds (4.8 in the 1604). It will probably rent for about $10,000 per month (the 1604 rents for about $34,000). Other specs are 8-32K core memory, average access time of 6.4 microseconds with overlapped core memory banks, real-time clock and program interrupt features.

LIGHTENING FLASHES, PART II

Soon after DATAMATION's July issue appeared with its initial report on RCA's efforts in Project Lightening, a booklet titled "Achievements in EDP" was published from Camden detailing further background on this subject which has apparently had its lid raised for an unclassified, public view.

In an article on "Development of a 1000-MC Computer," R. K. Lockhart, manager of Lightening Development Engineering, explains that the project was born as a result of a 1957 government request for a computer approximately an order of magnitude faster than anything then in the research stage. By mid-1957 a contract was signed for 18 months of intensive brainstorming and by the end of 1958, feasibility was proposed by three companies.

The government (BuShips) proceeded to assign a major category to each company with IBM to follow the cryogenics route, UNIVAC to explore thin films and RCA to develop microwave techniques. Work on transistors was forbidden in the contract since it was felt that this project would not be accelerated -- only subsidized -- and that the art of transistors would

be advanced as fast as commercial firms could move in this field. The contract did allow that the major effort could be supplemented by additional exploratory work wherever appropriate.

RCA soon branched into tunnel diode research and work is currently progressing at about ½ nanosecond/logic level, and such circuits as flip-flops, complete with "worst-case" tolerance analyses, have been developed.

The first major goal of hardware construction is to be a memory test unit, a small internally programmed computer to generate instructions and automatically carry these out in "leap-frog" sequence through every memory location to prove feasibility and reliability of the very-high speed circuits.

Simultaneous with the memory test unit, system design is being accomplished on a full scale machine. The basic philosophy of the study is that since the project will represent a major step in the state of hardware art, the system organization will remain conventional for the time being. Under this ruling, several designs have been compared and trial programming is being currently undertaken.

In another article by J. N. Marshall, manager, RCA Advanced Systems Development Engineering, the prediction is made that by 1966-68, medium and large computers will have memory cycles of about 50 nanoseconds and circuit delays of 1-2 nanoseconds. At somewhat greater cost, speeds of five times this figure will be available. Very roughly, a memory element now rents for 1-3 cents/month, and a logic element about 50 cents to $1/month. Marshall predicts that the first computers made from integrated circuits in 1964 will have logic elements renting at 2 to 5 cents/month and memory elements at under 1/10 cent before the end of the '60s.

BENDIX POSTPONES INTRODUCTION OF G-25

A long-awaited decision from the Detroit management of Bendix Computer on support of the company's solid state G-25, a successor to the 15, arrived last month. It was negative.

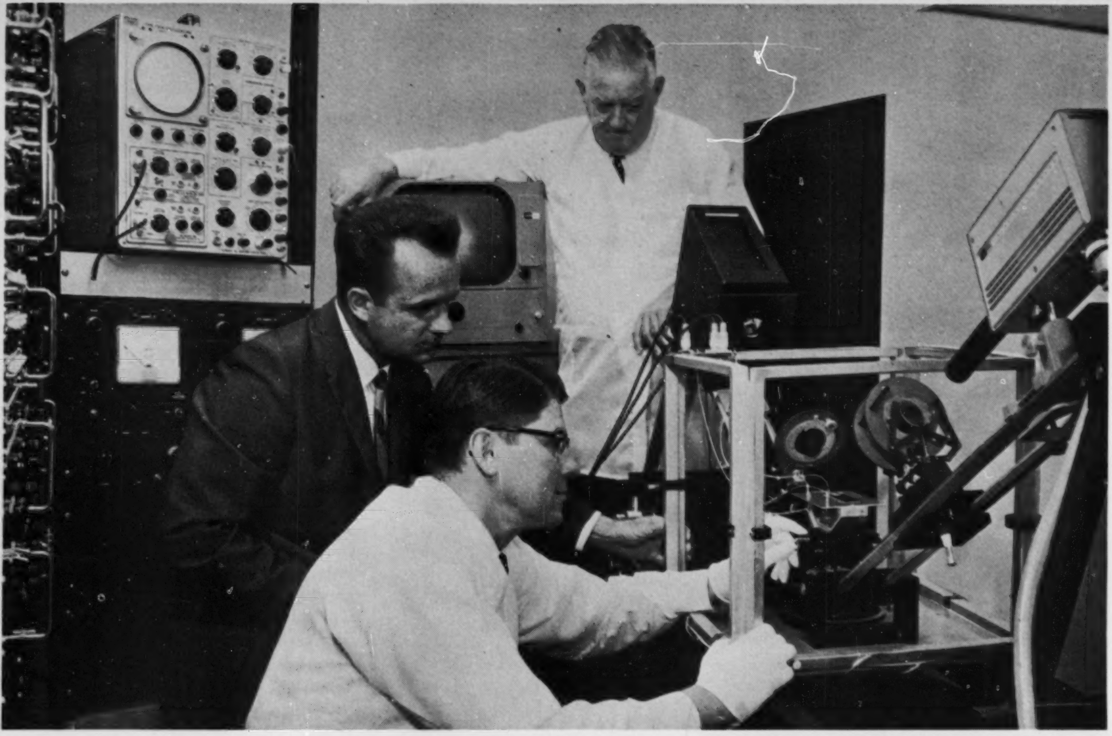
For some time, Bendix has devoted a small segment of its r and d effort to the design of the G-25 but full support for this program was not evident. Letters of intent but no orders were accepted. This official postponement is at best for a year's duration.

Meanwhile, the vacuum tube 15 continues to sell at least as many new machines as are returned each month and G-20 sales are improving at a gratifying pace with a production rate in excess of two each month.

HARVEST GETS A NUMBER

The 7950 is IBM's designation for HARVEST, a STRETCH-class machine under special contract "not intended for commercial availability." The numerical designation was published in the ACM program for this month's national conference in two abstracts for session 6C.

Many of the specs for HARVEST were presented last year during a large systems course sponsored by UCLA's Extension Division and at a previous WJCC at which a paper was presented on the TRACTOR tape system. As an example of the speed of the central processor, two characters can be processed and one character returned to memory in 200 nanoseconds. Tape speed is 235" per second.



Watching a magnetic thin-film shift register in operation: Mr. K. D. Broadbent (center) and Mr. A. W. Vance (standing) of the Research Laboratories, with Mr. G. Cokas of Technical Plans and Programs.

A special report from American Systems Incorporated...

Thin-Film Digital Devices

Supporting the trend in computer technology toward higher speeds, smaller size, and increased reliability, American Systems Incorporated has been conducting an intensive research and development program in thin-film digital devices.

The first of these, a microminiature magnetic thin-film shift register, is in the prototype production stage. This register, mounted on a 1-inch by 3-inch base, can store 256 bits and operate up to 1 megacycle per second. Originated by Kent D. Broadbent, ASI Research Laboratories scientist, the new register is characterized by precise bit definition, high immunity to noise, and low power requirement.

Advanced magnetic thin-film devices now under development include three-dimensional multiple plane systems. In these, complete logical sequences may be performed within the magnetic structure, without the need to convert information at intervals into electronic signals. Research interests include dielectric, conducting, semiconducting, and superconducting films, and crystal growth and ordering phenomena in films.

Complementing the work of the Research Laboratories, technical programs are under way at American Systems in six other Divisions:

INFORMATION SCIENCES
Mathematical and statistical research; computer programming, and advanced programming systems; computation services; digital system studies; logical design, advanced systems analysis.

DATA PROCESSING
Data processing subsystems research and development; logic of command and control complexes; optical recognition systems.

ELECTROMAGNETIC SYSTEMS
Electromagnetic physics; electronic and mechanical scanning antenna systems; development and manufacturing of complete sensor systems and special microwave components.

INSTRUMENTS
Research and development in analytical instruments; detection and monitoring of toxic high-energy missile fuel vapors; gas leak and water vapor detection; on-stream and process control instrumentation.

COMPONENT DEVELOPMENT
Advanced component technology; materials and processes; computer component development; chemical deposition of magnetic surfaces on drums, disks, rods.

AUDIO-VISUAL
Audio-visual (INSTRUCTRON) devices for assembly line and instructional applications; production of work stations designed on human factors principles.

Qualified scientists and engineers who are interested and experienced in these fields of activity are encouraged to investigate career opportunities with American Systems. All qualified applicants will receive consideration regardless of race, creed, color, or national origin.

AMERICAN SYSTEMS INCORPORATED

AMERICAN SYSTEMS *Incorporated*
1625 East 126th Street, Hawthorne, California
AN AFFILIATE OF SCHLUMBERGER

CIRCLE 7 ON READER CARD

letters

unmuddling

Commendations on your "Unmuddling" editorial for saying quite a few things that badly needed saying. May I suggest that if you haven't done so already you should send tear sheets of that editorial, if not complimentary "marked copies" (well-marked, that is) to several people who should have read it some time ago before saying so much that has indicated lack of homework perusal. I particularly have in mind the head of a well-known international consulting firm, who with his sycophants has learned the vocabulary of words ending in "-mation" and "-tronic" and appears to go on to greater heights with re-dos of their symmetrical arrangement. I also have in mind our esteemed Secretary of Labor and/or some of the gentlemen from Harvard who are attempting to steer our government from cloud 9.

If labor and government contrive to play the cards in exactly the right sequence we will awake one day to find that there has been a rapid completion of the project of unionizing office workers. It will include computer jockeys, and featherbedding to rival that of the railroads will have set in. The avowed purpose of this latter move will be rationalized, heaven knows how, under the guise of fostering "Progress in Paper Pushing" but will actually be the means of perpetuating what even the simple-minded will recognize as decadent office empires. Somehow mankind has managed to survive the transition from the quill pen stage, without anyone being offended but those whose cleverness ended at being able to put a fine point on the quills. We should be able to survive another transition, though it moves faster like everything else these days, and still find useful things for people to do.

W. M. Liddle,
National Director
National Machine Accountants Assoc.
Seattle, Washington

dear dr. grosch

Thank you from the bottom of my cockles for your refreshing article in

the July issue, "Through The Looking Glass" (with your fist.)

I'm not what you could call a real old-timer in the computing field, but I did write my first program nearly six years ago in absolute language. . . . The points you make in your article are certainly diamond-hard, and should be graven on the frosted glass of every true senior programmer's cubicle. These research boys ought to spend some time "on the line," sitting down with a proficient engineer who has a problem and relies on you to untangle the logic and produce some answers. I'm afraid they would be so concerned with the jargon, the millemicros, the supermacros, etc., that they would never really discover the key to success — time to think, a good reliable chunk of hardware with enough room inside to store the guts of the program, a faithful old friend of a symbolic assembler, and a brain that isn't too washed. The engineer is more apt to be timing you than timing the machine.

Spare me from being caught using terms such as "readout," "feedback," "problem-oriented," and "in-house." Let the 601's and 1107's and 2000's and 5000's and 20's grind out the brochures and software proposals. And let people like you occasionally needle the industry into avoiding woods-and-trees eyesight problems.

I feel better already, now that I've put in my $.00002K worth.

DAVID P. GLICK, JR.
Lafayette, Calif.

We suggest that you start a new group and call it "Algolics Anonymous!"

More power to you for your outspoken viewpoint.

JOSEPH E. WIRSCHING
Lawrence Radiation Lab.
Livermore, Cal.

NEXT MONTH IN DATAMATION

Some hurdles, hurrahs and hypotheses on the future of Information Retrieval will receive a thorough dissection in next month's special issue on this subject. Part Two of the RAND Symposium will feature a long-to-be-remembered view of ALGOL, and contributing editor Herb Grosch will direct his commentary at "Computer People and Their Culture." Other articles of note by Bob Bemer and Jackson Granholm are also on tap for October in addition to a bonus offering of near classic proportion on Chaostron: "a most exceptional learning machine."

important DATES

• The 12th National Conference on Standards is scheduled for October 10-12 in Houston, Texas. For information write to American Standards Assoc., 10 E. 40th St., N.Y. 16, N.Y.

• A conference on "Application of Digital Computers to Automated Instruction," sponsored by SDC and the Office of Naval Research will be held Oct. 11-13 in the Dept. of Interior Auditorium, Washington, D.C. For information write to Washington Liason Office, System Development Corp., 1725 Eye St., NW., Wash. 6, D.C.

• Univac Users Assoc. Fall Conference and USE meeting will be held Oct. 12-13 at the Warwick Hotel, Phila. For information contact Walter Edmiston, Philadelphia Naval Shipyard, Phila. 12, Penn.

• The 1961 Computer Applications Symposium, sponsored by Armour Research Foundation will be held Oct. 25-26, Morrison Hotel, Chicago. For information write to Benjamin Mittman, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

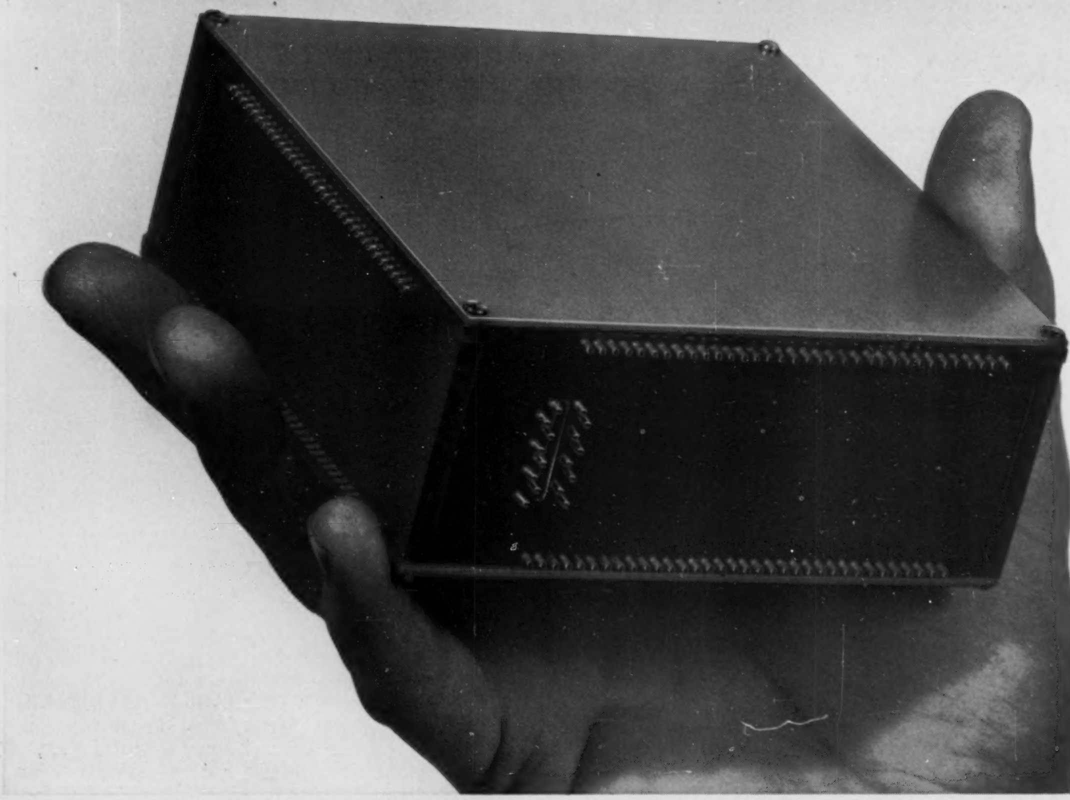
• The National Machine Accountants' Assoc. Electronic Business Systems Conference is set for Oct. 25-27 in Long Beach, Calif. For information write to NMAA Western Division, P.O. Box 7365, Long Beach, Calif.

• The Institute on Electronics in Management, sponsored by The American University will be held Oct. 30—Nov. 3rd at The American Univ., Wash., D.C. For information contact Prof. L. H. Hattery, The American Univ., 1901 F Street, N.W., Wash. 6, D.C.

• The 1961 Eastern Joint Computer Conference is scheduled for Dec. 12-14 at the Sheraton-Park Hotel, Washington, D.C. Theme of the Conference is "Computers—Key to Total Systems Control."

• The 1962 IFIPS Congress is scheduled for Aug. 27-Sept. 1 in Munich, Germany. For information write to Dr. E.L. Harder, Westinghouse Electric Corp., East Pittsburgh, Penna.

Now Pack More Data Into Every Cubic Inch with RCA HIGH DENSITY MEMORY STACKS...



TEMPERATURE CONTROLLED WITHIN ±2°C...DESIGNED TO MEET MIL SPECIFICATIONS

Occupying only 4.75 x 4.75 x 2 inches of space, this 4,096-word (8 bits per word) temperature-controlled magnetic-memory stack is available for a broad range of military, industrial and commercial computer applications.

RCA introduces new high density temperature-controlled memory stacks to meet the environmental extremes under which many of today's computers must operate. These new stacks incorporating RCA ferrite memory cores with specified wide operating margins are designed to cope with broad variations in power levels. In addition, they are built and tested to meet and exceed the environmental requirements of stringent military specifications.

MILITARY RELIABILITY: New RCA miniaturized high density memory stacks undergo and pass the MIL requirements pertaining to: Temperature Cycling, Vibration, Shock, Humidity, High Temperature, Barometric Pressure, Fungus Resistance, Salt Resistance. In addition, all stacks are 100 percent dynamically tested to assure the highest possible degree of dependability under actual computer operating conditions.

WIDE VARIETY: New RCA miniaturized memory stacks can be ordered in sizes to suit your requirements. Even the smallest temperature-controlled versions will maintain a temperature of + 85°C ± 2°C over free air temperatures ranging from − 55°C to ± 85°C. RCA temperature-controlled stacks reach their 85°C operating temperature in only 15 minutes.

With these new miniaturized memory stacks RCA now offers one of the industry's most comprehensive lines of memory components. RCA magnetic memory specialists are ready to custom design virtually any stack you specify.

SERVICE: Your local RCA Semiconductor and Materials Division Field Representative is prepared to provide a completely coordinated applications service covering transistors, tunnel diodes and other semiconductor diodes, ferrite components and memory systems. Call him today. For further technical information, write RCA Semiconductor and Materials Division, Commercial Engineering, Section 1-109-NN, Somerville, N.J.

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CIRCLE 10 ON READER CARD

people IN DATAMATION

■ The EDP division of Minneapolis-Honeywell has appointed Dr. Joseph H. Levin to the post of director of the newly formed Programming Division. Formerly director of systems analysis for the EDP division, Levin will now supervise over 150 persons employed in the development of automatic programming systems for Honeywell.

■ Dr. Maurice G. Kendall will assume the position of director for the mathematics, statistics and operations research departments of C-E-I-R (U.K.) Ltd., on October 1st. Kendall is presently professor of statistics at the University of London and president of the Royal Statistical Society, and past president of the British Operations Research Society.

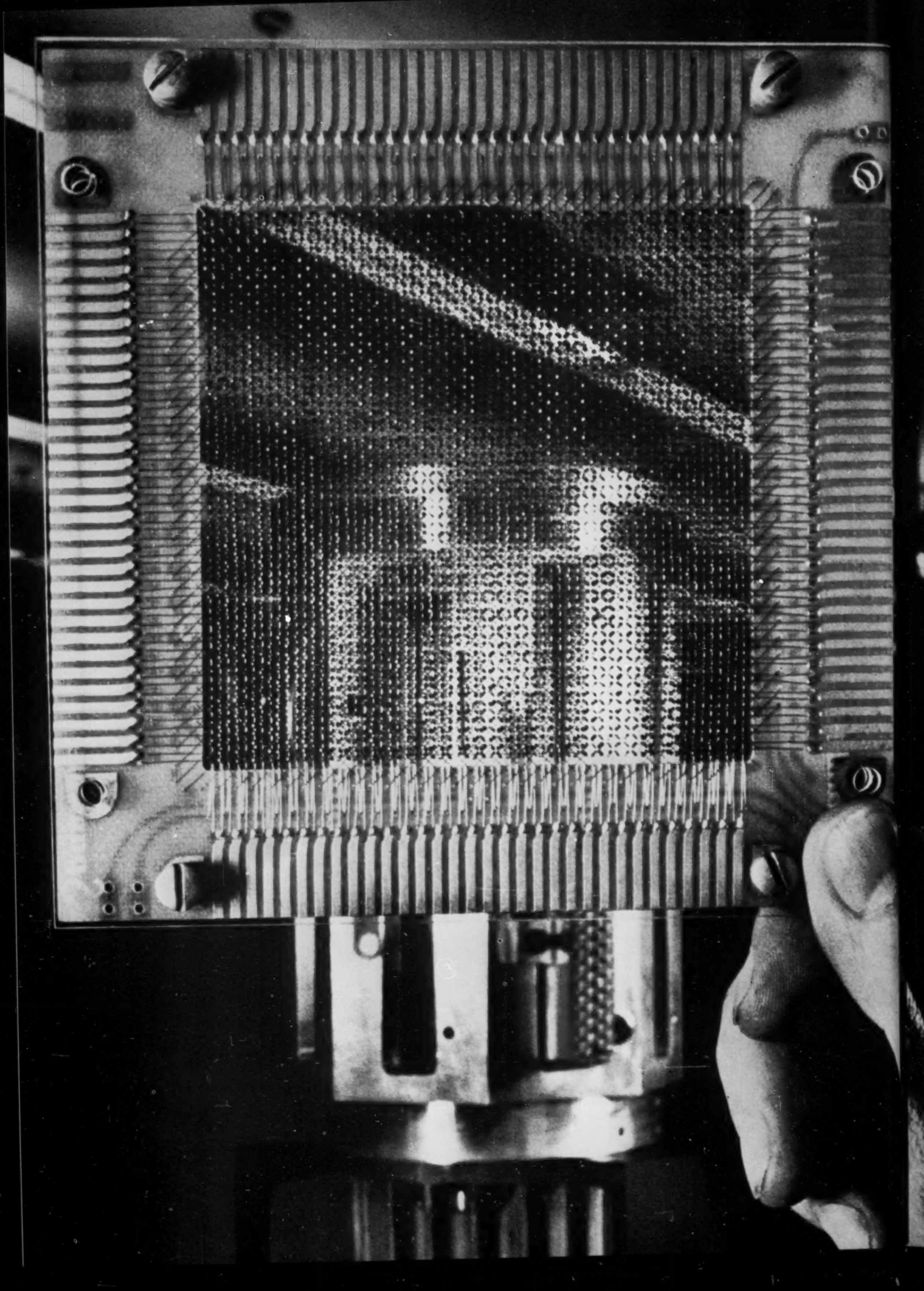
■ William E. Andrus, Jr., has been appointed group director of standards for IBM. In this newly created post, Andrus, who was formerly systems standards manager for IBM World Trade, will coordinate the company's standards efforts internally and with outside organizations.

MAC PANEL *computer tape* . . . ASSURED PERFORMANCE

MAC Panel Computer Tape is produced under rigidly controlled, scientific conditions to give you assured tape performance. *Manufactured for Performance* through the use of an improved oxide formulation that insures the presence and retention of the most critical magnetic properties as well as the prime physical characteristics: permanent coating adhesion . . . hard shell toughness . . . and flexibility under all conditions. *Tested for Performance* using procedures that far exceed the normal criterion for attention to detail. Every element in the new oxide formulation is tested before and after blending . . . every reel of tape produced is subjected to thorough tests which insure the quality of MAC Panel Computer Tape. *Packaged for Performance* in clean, dust-proof containers hermetically sealed inside a plastic envelope. This entire unit is shipped to you in a specially designed, shock absorbing package that features a "handy-handle" for carrying convenience. *Write for Free Booklet:* "MAC Panel Computer Tape . . . Assured Performance."

CIRCLE 13 ON READER CARD

MAC PANEL COMPANY ■ High Point, North Carolina MAC PANEL



At any remote location, a 1001 Data Transmission Unit reads punched cards and transmits the information over regular telephone lines.

IBM 1001 DATA TRANSMISSION SYSTEM
... new low cost way to send punched card data ... by telephone

This IBM 1001 Data Transmission System lets you send business information in punched card form, from any office, plant or department to your central data processing installation at the cost of a telephone call.

It speeds collection of information concerning inventory, purchases, payroll, production, etc., keeps you continually informed of what's happening in your business while it's happening.

And it does it at low cost.

A simple, desk-top 1001 Data Transmission unit and telephone at each remote location plus a telephone and card punch at your data processing center put you in business. The operator at the remote unit dials the data processing center, inserts a punched card into the transmission unit, adds additional information with the simple keyboard, and presses a button.

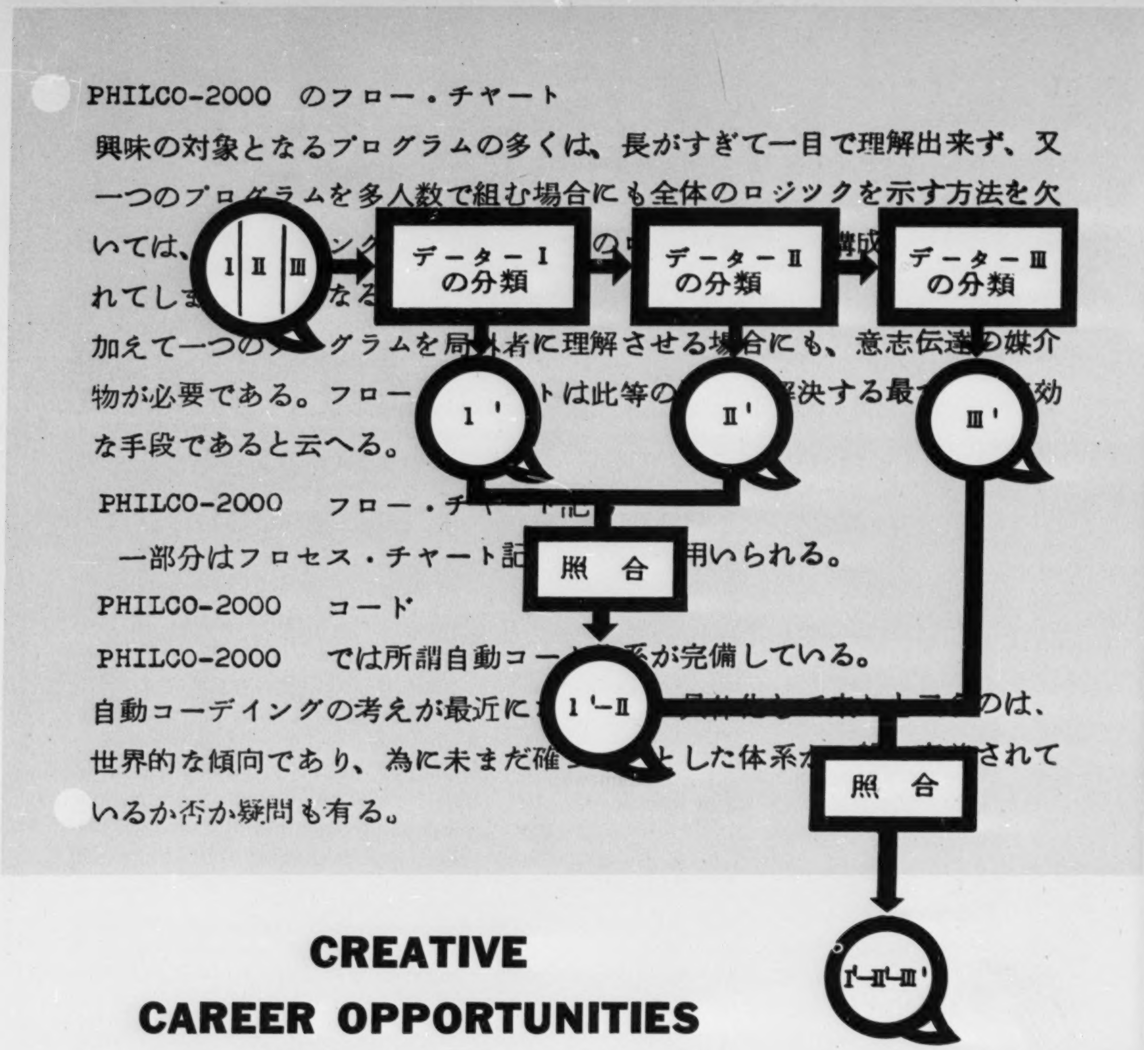
The rest is automatic. The equipment reads the card, transmits the information over your regular telephone lines, and reproduces an identical punched card, ready for processing. You can connect a number of departments, plants, offices or customers with this 1001 Data Transmission System.

This is another example of IBM TELE-PROCESSING* Systems which help business act faster by speeding up collection of the facts on which action is based. TELE-PROCESSING Systems are available for coordination of anything from a warehouse to an entire company.

*Trademark

At the data processing center, an IBM Card Punch receives data by phone and automatically punches it into a card, ready for processing.

IBM®
DATA PROCESSING



CREATIVE CAREER OPPORTUNITIES

The universal acceptance of the PHILCO 2000 Computer has created the necessity for the expansion of PHILCO'S Customer Services activity to include specially designed programming aids such as manuals, programs and other educational devices designed in the native tongue of the country involved. In addition, PHILCO offers its customers a wide range of training courses in Systems Analysis, Programming and Computer Operating Techniques. ■ Competent technical people trained for and skilled in these areas are required for pre-sales and/or post-sales support activities. Programmers, Technical Writers, Educational Specialists and Field Engineers experienced on large-scale digital computers are needed. Singular opportunities exist for scientists and engineers who have the imagination, drive and technical background to make significant contributions in the areas of Advanced Memory Systems, Computer Logic and Peripheral Equipment Design. ■ If you are seeking an environment which encourages use of your creative and analytical skills to maximum advantage, address your inquiry to:

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Professional Employment Manager
COMPUTER DIVISION
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EDITOR'S READOUT

THE ANNOUNCEMENT

Possibly no single word in computing has resulted in as sharp a perking of ears as "the announcement." It has signalled new competition; no competition; a dark, well-closeted secret disclosed; a much-talked about concept substantiated, and often, nothing much at all.

In a traditional sense, announcements are simply public declarations of a new product's availability. Quite naturally, hardware has held the primary spotlight but the softer wearables and consulting services are moving rapidly into the hazy glare of attention and the considerable confusions presently associated with announcements will undoubtedly be increased by several orders of magnitude.

Because of the infinitely complex problems of marketing and the matter of staying ahead of, or at least in line with one's fellow competitors, no degree of public preaching is likely to reverse this trend within the foreseeable future. It is not only symptomatic of the growing pains of a new industry, but it is shared to a large extent by many of the old, established suppliers in a variety of fields.

However, one objective in highlighting the problem is simply to provide a sturdier framework for user evaluation of what is and what isn't new, and what might and might not be expected as the result of an announcement. While it should be strongly emphasized that many perfectly legitimate unveilings have been made, we may assume that an announcement isn't always an announcement, and if not, then what is it? Some samples follow:

1. The Feeler. Its method is by an intentional dropping of a rumor, or the "privileged" presentation to a preselected few. Its purpose is to test the water without getting economically soaked. In the background, a breadboard or paper model may exist with a little hope and not much money. A few orders would help, and too many would be embarrassing. The feeler has become in effect, an inexpensive form of market research.

2. The Blast. Its method is the "big" press conference, a large budget for promotion in Time and Fortune, etc. It is sometimes preceded by an announcement of an announcement. Its purpose is to create attention, inflate stock values, and convey the impression of being "first." In the background, a genuinely valuable concept may be reasonably ready for translation into working hardware, and a reliable service or software package offered. It is unlikely that a great deal of money is to be spent on heated air, but the possibility always remains.

3. The In-Between. Its method is generally intermediate in intensity consisting of a bulky press release and modest advertising. Its purpose is to sell hardware which is frequently neither novel or superior but the market and price are generally attractive. In the background, the firm may have produced six machines for the Navy of which two were actually delivered and four remain. If seven orders are received, three additional units could be constructed. In addition, the machine may be reasonably similar in design to a competitor's model and too big a splash would be arrogant and unnecessary. The groundwork has already been laid.

A large grouping of announcements may also feature the methods of any

of the aforementioned categories but have distinguished backgrounds of their own and warrant attention.

1. The Tail Fin. This approach is based on the tested techniques of the automotive industry in which a "new" machine or for that matter, 16 "new" machines are simultaneously marketed. In reality, the "newness" is only the numerical designation or the color of the console and the "16" may actually be one machine in a multitude of enticing configurations.

2. The Government is Looking. One of the principal advantages of operating under the consent decree is that everyone knows it and expects that what is announced and promised will generally be delivered. This fact is perhaps the best, single piece of unpaid publicity a company could have obtained by simply being sometimes bad and mostly just big.

3. Tried and True. The installation of several machines prior to formal announcement is in effect, a pre-announcement but effective as a form of testimonial and if the testimonial is negative, the embarrassment is comparatively slight.

4. The Surprise. And surprises are rare indeed so that one reason for utter secrecy may simply involve the final pushing of old models under the guise of a lengthy waiting list. Other reasons for surprises: poor coordination between engineering and sales departments; a "privileged" presentation to the wrong user who actually kept the secret, and finally, a mistaken notion that machines can be sold by inducing a state of shock.

Extension of this list could prove an almost endless task but the point should be apparent: it is essential for the user to differentiate between what is said for public consumption and what may be fact. If an analogy is still needed: the road is unpaved and bumpy but it's far better than strolling in the ditch.

A CHRONOLOGICAL LISTING OF COMPUTING POWER

(BASED ON THE CHARLES W. ADAMS ASSOC. COMPUTER CHARACTERISTICS QUARTERLY)

VACUUM-TUBE SYSTEMS

(still widely used)

3/51 — UNIVAC I
/53 — IBM 701
1/54 — Burroughs 205
11/54 — IBM 650
/55 — Alwac-IIIE
/55 — IBM 702*
8/55 — Bendix G-15
3/56 — IBM 705
3/56 — UNIVAC 1103A
4/56 — IBM 704
9/56 — RPC LGP-30
/56 — Burroughs E-101
11/57 — UNIVAC II
12/57 — IBM 305 Ramac
1/58 — UNIVAC File Computer I
8/58 — IBM 709
9/58 — UNIVAC 1105
12/58 — Burroughs 220

SOLID-STATE SYSTEMS

(delivered 1958-61)

11/58 — Philco 2000-210
11/58 — Recomp II
10/59 — IBM 1620
11/59 — IBM 7090
11/59 — NCR 304
11/59 — RCA 501
1/60 — Control Data 1604
1/60 — UNIVAC SS 80/90
3/60 — Philco 2000-211
5/60 — Monrobot XI
5/60 — UNIVAC LARC
6/60 — IBM 7070
7/60 — Control Data 160
9/60 — IBM 1401
9/60 — RPC 9000
11/60 — DEC PDP-1
11/60 — General Electric 210
11/60 — RPC 4000
12/60 — Honeywell 800
12/60 — Packard Bell 250
2/61 — Bendix G-20
2/61 — RCA 301
3/61 — General Electric 225
3/61 — Ramo Wooldridge 400
4/61 — NCR 310
4/61 — IBM 7030 Stretch
5/61 — CCC DDP
5/61 — NCR 390
6/61 — Recomp III
7/61 — CDC 160A
8/61 — CDC 924
8/61 — IBM 7080
8/61 — Ramo Wooldridge AN/UYK-1
9/61 — Honeywell 400
9/61 — RCA 601
12/61 — IBM 1410
12/61 — UNIVAC 490

(To be Delivered in 1962)

Burroughs B5000
NCR 315
IBM 7074
IBM 7072
Philco 2000-212
Philco 2400
UNIVAC 1107
UNIVAC III

*Many computers delivered in 1953 through 1958 but no longer being produced have not been included in this list; the 701 and 702 however, appear here for old time's sake.

DATAMATION

QUARTERLY INDEX OF COMPUTING

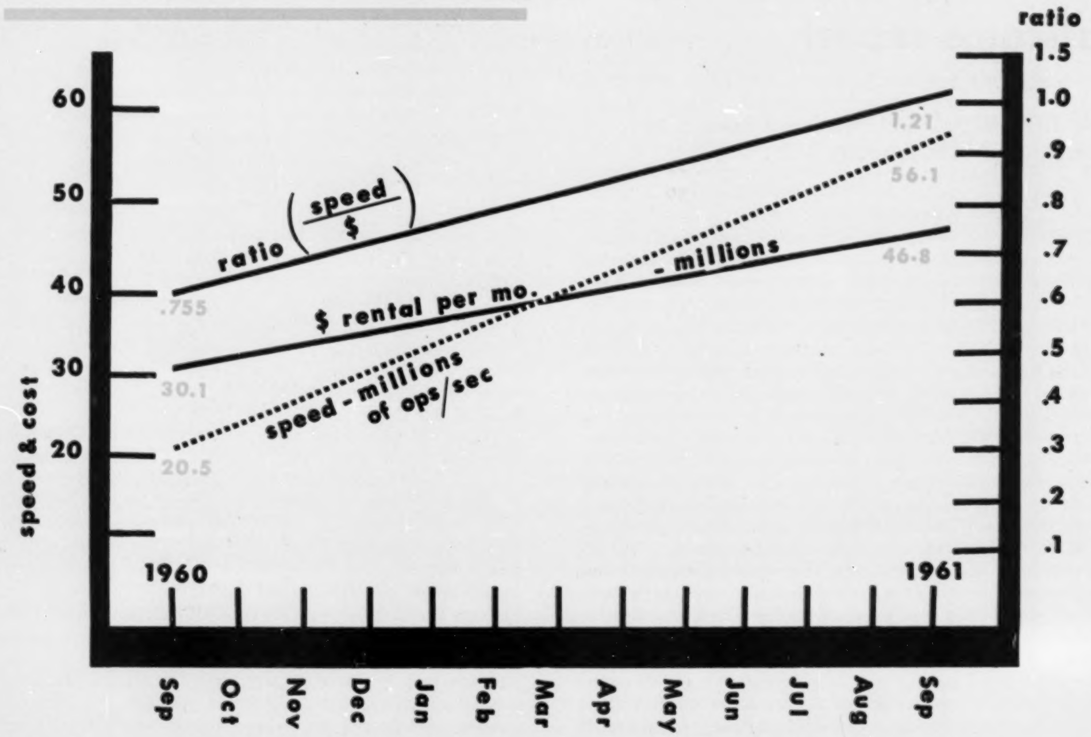
Total computing power, dollar rental volume, and computing power per dollar for operating U.S. computers

Apparent in this second publication of the Quarterly Index of Computing (the first chart appeared on p. 21, June issue), is the continued sharp increase in speed from 40.8 million ops/sec. in June to 56 million ops/sec. for September.

This is attributable in large measure to the inclusion of more than 500 1401 installations which have been formerly announced and over 400 1620 installations.

In the previous Index, smaller systems were approximated in total number of installations, and an estimate of speed and rental was based on this figure. The increasing number of solid states in the small to medium class substantially influences this approximation and specific estimates have now been tallied.

It is interesting to note that despite the 28.1% rise in speed for the past three months, dollar rental and ratio of speed/ops per $ have increased only 13%, attributable to the continued decrease of cost of ops per $ as solid states continue to replace slower tube machines. ■



One of the major objectives of automatic computer programming is to break down the communication barriers between humans and computing machines. Sometimes efforts have gone astray and it is as though people were knocking down sections of walls where it is easier to walk around, or the production of scaling scaffolds has succeeded only in producing greater obstacles to getting over the wall. Nevertheless, many products of automatic programming efforts have demonstrated great economic value.

ALGOL-60

a status report

by J. H. WEGSTEIN, National Bureau of Standards, Washington, D.C.

In spite of the risk of misadventure, efforts to improve the communication with computers have led to the development of numerous artificial computer languages such as FORTRAN, ALTAC, IT, FLOW-MATIC, COBOL, ALGOL, LISP, COMIT, IPL, JOVIAL, MAD and NELIAC. Some of these languages, such as FORTRAN, have found widespread productive use. Others, such as LISP, COMIT, and IPL are valuable research tools. These languages might be classified according to their use for: (1) person to machine communication, (2) person to person communication, and (3) a basis for building new concepts. The latter use is evident with the emergence of such concepts as push-down lists, dynamic memory allocation, tree memory structures, and the applications of recursive function theory.

Another step in artificial language development has centered around the idea that it is desirable to be able to exchange computer programs between different computer laboratories, or at least between programmers, on a universal level. There are two problems in this effort: one is to obtain a language that is technically sound; the other is to persuade enough people to use the language so that there can be an exchange of useful computer programs. It is very difficult to determine when a particular language strain has developed to the extent that it can be accepted as a universal language, and there is always a question as to whether the standardization of a language might retard or advance progress in the computer field.

In spite of the risk of great misadventure, two languages, ALGOL and COBOL, have been proposed as common languages in the area of scientific computing and business data processing, respectively. This report is concerned with the status of ALGOL.

ALGOL 60 defined

ALGOL 60 was defined by a conference of thirteen representatives from Denmark, England, France, Germany, Holland, Switzerland, and the United States held in Paris in January, 1960. In addition to several English publications [1-3] the report of this conference was published in French[4] and German (East Germany). The proposed language then began the long, slow climb toward acceptance.

publication of algorithms

Perhaps the first impetus for ALGOL 60 came from Germany. The Springer publishing firm has elaborate plans to publish a monumental handbook on numerical computation and it was soon decided that all mathematical computations would be written in ALGOL 60. The numerous contributors from both Europe and the United States were therefore obliged to gain acquaintance with the language, and some contributors have found it very

satisfactory. The handbook editors plan to publish suitable algorithms in *Numerische Mathematik* before they appear in the handbook.

In the United States the ACM *Communications* opened a section on algorithms and each month publishes one or more algorithms written in ALGOL 60 along wih remarks and certifications of previous algorithms. With the September 1961 issue, 69 algorithms ranging from equation solvers through matrix inversions and linear programming codes have been published. This library of algorithms, along with their certifications, is expected to become a reference of considerable value in the computer field. These algorithms are not copyrighted and may be freely used – even by Springer. An early reward for this effort came when certain top-level mathematicians wrote programs which can readily be used in laboratories that cannot employ such high caliber personnel. The language promises to be useful for communication within special interest groups such as crystallographers and linear programmers.

The new quarterly journal *Nordisk Tidskrift for Informations-Behandling* (or BIT for short) supported by the Scandinavian countries including Finland and Iceland also publishes algorithms[5] written in ALGOL 60 as well as articles on ALGOL 60.[6-7]

ALGOL maintenance

A series of ALGOL Bulletins prepared at the Regnecentralen, Copenhagen has carried on an extensive discussion of details of ALGOL among individuals from Europe and Asia. Although many suggested interpretations, corrections, and changes have appeared in the Bulletins, the tenor of the correspondence is that no changes to the wording of the ALGOL 60 report will be officially adopted for the present, and no European ALGOL maintenance group will likely be formed at the present time.

In November 1960 a working conference on ALGOL was held in Moscow attended by representatives from Novosibersk, the Steklov Institute, the Computing Center of the Academy of Sciences, and Moscow State University. The participants felt that a continuation of the common work on the perfection and sharpening of ALGOL was necessary, and indicated a willingness to participate in the ALGOL Bulletin correspondence.

In the U.S., an ALGOL Maintenance Group was formed in August 1960 as a subcommittee of the ACM. This group consists of about 58 members from 28 universities, computer manufacturers, and other laboratories, and probably includes all manufacturers and universities that are building ALGOL compilers. The criteria for membership are that members (a) have written, are writing, or plan to write ALGOL-like compilers or are actively engaged in writing programs in the ALGOL 60 language, *and* (b) are willing to maintain ALGOL 60 as a Reference Language. Most of the business of this group is conducted by mail. There has been a surprisingly small amount of technical correspondence among the members of this group, and the group seems to exist mainly to stabilize ALGOL. An organization that invests heavily in building an ALGOL compiler is very much interested in having some control over any changes that might be made in the language. The tenor of the U.S. group now seems to be the same as that of the European group: no changes to ALGOL at the present time.

compiler implementation

Many computer manufacturers, universities, and programming service companies have written or are writing compilers for ALGOL or subsets of ALGOL. In Europe a number of organizations have joined in an effort sharing group called ALCOR and others are working independently. A survey made by the ALGOL Bulletin in 1960 indicates the following activity in ALGOL compiler construction:

ALGOL Compiler Construction In Europe

Place	Man Years
Mathematisch Centrum, Amsterdam	2
Dutch Postal and Telecommunications Services Leidschendam	2.5
AB Atvidabergs Industrier, Sweden	3
Zentralinstitut fuer Aulomatisierung, Jena	5
Institute of Mathematics, Novosibersk (USSR) (complete language, punched cards)	15-20
Svenska Aeroplan Aktiebloaget, Sweden (members of ALCOR group)	
Rechenzentrum der Technischen Hochschule, Munchen	.5
Swiss Federal Institute of Technology, Zurich	1
Institute fuer Angewandte Mathematik, Bonn University	.5
Siemens und Halske AG, Munchen	
Institute fuer Praktische Mathematik, Darmstadt	.25
Regnecentralen, Copenhagen	3

In March 1961 a preliminary ALGOL compiler was completed at Kyoto University, Japan.

No precise survey of ALGOL compiler activity in the United States has been made, but 24 organizations in the ALGOL Maintenance Group have engaged in compiler construction or have contracted for compilers for their computers as follows: Armour Research Foundation, Bendix Computer Division, Burroughs-Electrodata, University of California, Case Institute of Technology, University of Chicago, Georgia Institute of Technology, Lockheed Aircraft Corporation, National Bureau of Standards, Navy Electronics Laboratory-San Diego, University of North Carolina, Northwestern University, Oak Ridge National Laboratory, University of Pennsylvania, Institute for Defense Analysis, Remington Rand Univac, System Development Corporation, Sylvania Electric Products, Computer Associates, RCA, Carnegie Institute of Technology, Royal McBee Corporation, IBM, and Dartmouth College.

ALGOL publications and usage

The main criticism of ALGOL, which can be found in a few excellent critical papers,[8-11] centers around a few ambiguities that exist in its definition. However, most people who use the language naturally use it in a way that avoids these difficulties. For the most part, the supporters of ALGOL feel that these difficulties do not warrant reversing ALGOL 60 at the present time. Compilers should be constructed in such a way that programs which are unambiguously defined by the report will be correctly translated. Programs which are ambiguous should be considered as not defined. A recent formal vote taken in the ALGOL Maintenance Group found a majority of the members in favor of not attempting to revise it at the present time.

In addition to introductory articles on ALGOL,[12] there have been numerous articles on implementation.[13] (The entire January 1961 issue of the ACM Communications was devoted to compiler construction.) Also, after many

requests, two excellent primers for ALGOL have been written.[14-15]

conclusion

This report was written in response to recent intimations that ALGOL is or should be on the wane. One is reminded of Mark Twain's response to rumors that he had died: "The reports of my death have been greatly exaggerated."

Physicists define momentum as equal to mass times velocity and it is impossible to estimate the momentum of an object by observing only its velocity. A very massive object may have a large momentum even though it is moving very slowly. Similarly with ALGOL, the momentum of the movement cannot be judged by the speed with which the language is being put into use without also observing the number of people who are working with it.

At this time, the future widespread use of ALGOL for publication and teaching purposes seems certain. It is rather easy to translate by hand from ALGOL into various computer languages or into other artificial languages similar to ALGOL for which compilers now exist.[16] The permissibility of many hardware languages that are only similar to the ALGOL publication language may be essential to giving the publication language a foothold. Yet, as time goes on, the urge to "stand closer to the trough" will surely lead to compilers which bring the computer very close to the ALGOL publication language. ■

NOTES

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LINCOLN LAB'S FX-1

a third generation model

One of the fastest digital computers ever constructed is now in operation at the M.I.T. Lincoln Laboratory in Lexington, Mass. Known as the "FX-l," this new computer is in many respects a working model for a new generation of machines, ten times faster than most computers in general use today.

It is the first machine with a main memory using thin magnetic films in place of ferrite cores for high-speed, random-access storage. FX-l is designed to be a complete, small-scale, general-purpose computer, for realistic tests of fast logic circuitry and magnetic film storage in system operation.

memory

The read-write cycle time for the central memory of the FX-l is 0.3 microsecond. The fastest main memories in machines today have cycle times that generally range from 1 to 12 microseconds. The largest core memory in existence, with a capacity of more than 2,500,000 bits, was built by Lincoln some four years ago and is part of the older Lincoln TX-2 computer which has a read-write cycle time of 6.5 microseconds.

Also a part of TX-2 is a small fast memory using thin magnetic films, the first such memory to be installed in a computer. In regular use for almost two years, this magnetic film memory operates in TX-2 with a cycle time of 0.8 microsecond, consistent with its functions in the computer itself; in bench tests, a cycle time of 0.4 microsecond was attained, limited by the performance of the transistors that were available at the time the memory was built.

The initial FX-1 memory has a capacity of 256 words of thirteen bits each, but provision has been made to increase the initial capacity by a factor of four. This memory is large enough to serve the purpose of FX-1, to provide a realistic test of fabrication and operating techniques, and at the same time to provide sufficient storage to enable the machine itself to be useful for some practical purposes. Because of the high speed of the logic circuits and the short cycle time of the memory, the FX-1 can match the performance of considerably larger conventional machines.

The memory employs printed-circuit wiring on a flexible sheet of resin-impregnated glass-fiber cloth. Two halves of flexible wiring sheet are mounted on stiff backing boards, leaving a flexible hinge between the halves. The arrays of memory elements, deposited on thin glass backing plates, are positioned on the wiring so that each magnetic-film element rests on the intersection of two perpendicular leads on the wiring sheet. When all the memory element arrays are in place on the lower half of the wiring sheet, the upper half is folded over to make the completed memory, with associated circuitry. This single unit contains the 3328-bit memory of the FX-1 computer. ■

WHAT COBOL ISN'T

a temperate evaluation for implementation

by HOWARD BROMBERG, Manager, Automatic Programming, RCA

Much has been said concerning the historical development of COBOL, as well as a description of the elements of COBOL. It is the purpose of this paper to mitigate the passion, vehemence, and gusto surrounding COBOL by presenting certain areas which contribute to the overall benefit or detriment to the COBOL user. It is of paramount importance for those contemplating the use of a COBOL compiler to consider it not as an academic step toward a common programming language, but rather as a practical method for the solution of their particular problems. Consequently, it is hoped that the following discussion will present a temperate evaluation of the COBOL system as a guide for those considering jumping on or off the COBOL bandwagon.

Currently, twelve computer manufacturers are publicly committed to the implementation of COBOL compilers for thirty different computing systems. Let us consider the reasons behind the development of COBOL. (Please note that the order of the next two statements is intentional.) First, COBOL was created to be a powerful and effective tool for the solution of data processing problems. Second, COBOL was created to provide groundwork for eventual program compatibility.

How are we to evaluate COBOL's problem solving abilities? Three principal areas may serve as guides: first, the amount and kind of information supplied concerning the actual use of the compiling system; second, the marriage between the compiler and the computer; and third, the compatibility of the compiler with the other programs supporting the computer.

Not the least important are the amount and kind of manuals produced by each implementing manufacturer. These manuals are necessarily some reflection of the original specification manual published by the Government Printing Office. The specifications for what has now become known as COBOL 1960 were distributed by the Government Printing Office starting in July of 1960 and currently 16,000 copies have been sold. This manual was not intended to be a guide for the users. This manual, which is a product of the various manufacturers participating in the development of the COBOL specifications, was designed as an implementer's guide. That is, the Department of Defense Specification Manual was the set of rules agreed upon by each manufacturer represented on the COBOL committee as to how the various COBOL compilers should be implemented. As far as the user is concerned, he is not able to write programs using this implementer's guide for compiler building as his set of rules. Consequently, when considering a COBOL compiling system, one must give a great deal of emphasis to the type of manuals that are presented.

The first manual which the user ought to expect is a manual which would be his guide for writing programs. This is the direct interpretation of the Department of Defense specifications by the particular implementing manufacturer. It is this manual, called *The User's Primer*, which contains not only the actual rules under which the particular compiler was implemented, but also examples demonstrating clearly how the user is to employ this set of rules for writing COBOL programs for his particular computer. More precisely, all of the various constraints and restrictions, all of the formats as they pertain to the given computing systems are reflected in *The User's Primer*. This manual prescribes the way in which programs may be prepared for subsequent compilation.

The second manual or second type of information which ought to be supplied might be called *Program-*

ming Aids. It is the function of this kind of manual to show the programmer how to "help the compiler." In order to better understand this particular philosophy, we must consider the compiling system to be an extension of the computer hardware. Just as the compiler helps the user in the preparation of his programs—because of its employment of the flexible language, COBOL, so the user must help the compiler employ the computer most efficiently, for example, by presenting data in certain formats. It is therefore, the function of the information in *Programming Aids* to supply clues, hints, and directions to the user concerning exactly how the COBOL elements should be used to most properly establish an effective rapport between the compiler and the computer. For example, *Programming Aids* should describe the most effective way to establish data for certain types of operations to be performed on those data. Depending on the particular computer's data configuration or data arrangement, *Programming Aids* would suggest to the user whether various data items should carry a sign, whether these data items should be fixed in size or variable. This kind of information is most helpful to the systems designer when he is interested in obtaining from the compiler the most efficient object program. To continue with this type of information, we must recognize the fact that compiling systems are not magical. That is, every single machine instruction that is generated by virtue of the compilation process can be predetermined. Clearly, it is predetermined by the implementer. It is also the function of *Programming Aids* to supply this kind of predetermination information. More precisely, for every single COBOL statement, for every clause or element of COBOL that is used, the COBOL programmer should be presented a means of determining from his source program, before compilation has been attempted, exactly what the object program will look like. For every statement, for example, depending upon the type of statement and the number and type of the operands within the statement, the actual number of generated machine instructions should be supplied. In addition, a way to determine the number of constants and literals that will be required in object program memory, as well as all information concerning memory that will be allocated by the compiler must be given. This should also include the size and allocation area for all of the various routines that are automatically supplied by the compiler. For example, the size and location of various Input/Output routines should be specified. With this information, before compilation is attempted, the user may determine the size of his segments; in addition, he may determine the actual coding that will be supplied by the compiler's generators. In this manner, *Programming Aids* allows the user to become more familiar with the actual mechanics of compilation and, consequently, gives him a much better appreciation for his particular compiling system, as well as the ability to work more efficiently with it.

The third type of information which ought to be supplied is called *Compiling Aids*. *Compiling Aids* should describe the actual operation of the compiler. This information, of course, is necessary for all those involved in the actual compilation process. Also, correction procedures must be carefully documented. Those methods which allow correction of the source program should be described in this manual. In order to help the user satisfy his correction needs, every compiler must create cross-reference and error-message listings. It is the function of *Compiling Aids* to help the user to benefit from the various messages, cross reference listings, and correction procedures. For example, every compiling system must supply the mapping of every single character position in the object program memory. This should be done on two levels: first, the original on the source program language level; and second, on the object program language level. During the compilation process error conditions or indications are noted by the compiler's diagnostic processes. *Compiling Aids* must describe the exact meaning of the various error messages. More precisely, it must specifiy exactly what the message is, what the computer condition is, what the compiler condition is, and what programmer action is required. Now, this programmer action directly affects the various debugging aids. Depending on the type and nature of the error message, the programmer must examine the various listings that the compiler has presented to him in order to determine the precise nature of his error. *Compiling Aids* ought to describe means for debugging programs in the same language in which they are written, namely, COBOL. Finally, *Compiling Aids* ought to tell the user how to execute his compiled object program.

After learning how the compiler works, how to write programs for it, how to operate it, and what it produces, there is yet another major consideration. On the one hand, we are able to determine exactly how the compiling system reflects the particular input language. On the other hand, we must determine how the compiler works with the actual computer hardware. A compiler is nothing other than an extension of the computer hardware. As an extension, it allows a greater number of people to write programs with greater facility. However, the question is, At what expense do we gain this facility? It is not unreasonable for a user of the new, large-scale computing systems to expect, and even to demand, that those expensive features for which he is paying should effectively be accommodated by the compiling system. For example, imagine a compiler written for the RCA 501 computer; if it does not accommodate variable-word-length processing and simultaneous read, write and compute, it would neither be an adequate reflection of the state of automatic programming art nor of computer design. In addition, the modular design of today's computing systems should be reflected in compiler implementation. That is, the user with a computer having 12 magnetic-tape stations and a 16,000-character memory should expect his compiler to take full advantage of this configuration rather than the minimum of six magnetic-tape stations and an 8,000-character memory.

Another important consideration in compiler evaluation is its place within a total programming systems complex. A compiler, like other programming tools, must be consistent with the integrated systems approach used for the particular computer. As an example, it would not be unreasonable to assume that the same type of debugging macro instructions used in an ALGOL compiler should also be included within the source language of the COBOL compiler for the same computer. The standards adopted for sorting and other service routine functions should be reflected within the compiler so that each user is offered a total and consistent library of programming aids. On the output side, the compiler must prepare object programs which also operate within this systems complex. Namely, if there is an operating or executive routine, all programs produced by a compiling system must operate under the control of such an executive package. In addition, these object programs must have built into them the ability to take advantage of the existing conventions such as multi-programming, which requires programs to be in a "floatable" condition—as well as any existing Input/Output configuration or standards which are required by the manufacturer's operating system.

In summary, the programs produced by a compiler should look exactly like those programs which would be hand-tailored in machine code. They should be designed so that they take full advantage of all the peripheral routines, standards, and conventions already established within the manufacturer's systems concepts.

With these notions of compiler evaluation in mind, let us now consider some of the particular aspects of COBOL compilers. A very important consideration is the notion of COBOL program compatibility. Compatibility, in this sense, implies a program-sharing ability, which is accomplished automatically by taking a COBOL program originally written for one computer and compiling it on another type of computer. There are two major interpretations of the notion of compatibility. In the classical sense, we may consider that compatibility is quite analogous to the notion of "round" or "perfect." In this sense, we must maintain that there is no COBOL program compatibility. On the other hand, we may consider the notion of partially compatible, nearly compatible, almost compatible, or on-the-road to compatibility. In this sense, we see that the problems oriented on computer independent elements of COBOL are harmonious, are, indeed, compatible. Thus, COBOL programs, in the practical sense, are compatible when one considers that the compatibility desired may be contained entirely within the Procedure Division. In no sense may we advertise that COBOL is automatically compatible. It is almost certainly not the case that a program written in COBOL for computer X can be compiled by computer Y without alteration. What we can say is that the work of modifying such a program is substantially lessened because COBOL was used as a source language.

Complete compatibility presents too many overwhelming aspects. For example, complete compatibility would require each compiling system to possess a precise knowledge of the data handling techniques of every other computer which has a COBOL compiler. Consequently, whenever any new computer with a compiler is produced, every existing compiler would have to be provided with information about this new computer.

On the other hand, the ground-work upon which one can eventually build a practical and usable compatibility mechanism has been demonstrated by the COBOL compilers. One approach to complete compatibility would be the creation of a completely machine-independent data description. Each compiling system would have the same description of all data, from which it would be able to create that particular data organization which most effectively utilizes its computer capabilities for data organization which most effectively utilizes its computer capabilities for data processing. In a sense, then, the compiler would be given the extra duty of specifying for the particular program or for the system or installation exactly how files should be established in order to take maximum advantage of the computer itself.

As far as the Environment Division compatibility is concerned, I believe that this is so minor an area that it is not outrageous to insist that every user rewrite the small amount of hardware dependent configuration information for each program which is to be compiled anew.

A further consideration in the area of program compatibility within the COBOL cosmology is the proper choice of particular compiler features. This means that care must be exercised when writing a program which is to be compiled by and executed on more than one computer. It is necessary to guard against the use in the "original" program of features which do not appear in the "other" compiler. Compatibility in the COBOL sense, then, involves both data compatibility and compiler compatibility.

All of the foregoing has been leading to the following point. COBOL isn't the answer to the programmer's prayers or to the manager's dreams. As with most tools, proper utilization will sometimes produce better results and other times the same results with greater ease. In this view COBOL is a device which, rather than accepting the full responsibility for producing the proper solution, accepts only part of this responsibility. The other part of this responsibility is the programmer's: he must help the compiler just as the compiler helps him. The type of help that a compiler needs is the preparation of proper input data. Input data takes two forms: One is the establishment of the particular data files which the program is to manipulate in just that individually suitable arrangement which most effectively utilizes the computer's ability to process data. The second form is the proper synthesis and analysis of procedures that the compiler is to follow in order to turn out an adequate and efficient solution of the particular problem.

In no sense can we consider that COBOL is a substitute for good systems synthesis or analysis. The notion that installations may exist with a COBOL compiler and without individuals who are knowledgeable concerning machine programming or the details of a computer is utterly without foundation. In order to benefit from the use of a COBOL compiler, every installation must necessarily contain at least one individual who is sufficiently knowledgeable in systems synthesis and analysis and in programming practices to be able to establish a system in harmony with the features of its computer. With good systems design and with proper data descriptions, the COBOL compiler can be a very big help to the programmer.

Improper direction of a computer, which in our terms means improper COBOL programming, will produce for the user just that degree of intelligence and sophistication in his object program as he has put into his input design. One gets out of a compiler only as much as one puts into it. The compiler is consistent in its processng of data.

Too long has the user been an economic slave to his computer. COBOL may be his emancipator. There must, however, be more user influence exerted in this area of COBOL. This is necessary to increase the power of the language and to guarantee that the user will not become a slave to his COBOL compiler. With proper evaluation and intelligent use, a compiler can be a very important part of successful computer utilization. What COBOL isn't is the final answer; what it is is what you make of it. ■

ABOUT THE AUTHOR

Supervising the design and development of compilers and assembly systems for RCA's dp division, Howard Bromberg has represented the company on the original Conference on Data Systems Languages organization which was responsible for the specification of COBOL. He is currently a member of both the ASA X-3 committee on common programming languages and the COBOL maintenance committee.

BULL'S RULE IN EUROPE

a decade of Gamma spurs it on

Bull Machine Company, Paris, continental Europe's largest computer and peripheral equipment manufacturer, exports more than one half of all its production to countries outside of France.

The world-wide network of Bull offices spreads from Latin America, through the British Commonwealth and into all of the European countries. Sold and distributed through these outlets is a variety of systems and equipment for computer applications.

At last count Bull had 20 agencies and branch offices handling exports to over 40 different countries.

The actual manufacturing and development operation of Bull is nearly as decentralized as its sales organization. Altogether there are ten plants scattered throughout Europe turning out Bull equipment.

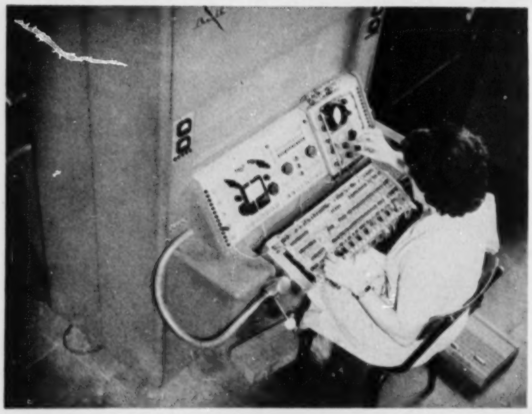
Using Paris for its main headquarters, Bull operates specific plants for punched card equipment, relays, cables, assembly of small components, punching and control, tabulators, and mechanical and spare parts. The Paris headquarters is the location for the assembly of the Gamma 60. These plants have an approximate square footage of 1,260,000 sq. ft.

Bull's activities can, in broad terms, be divided into eight main areas. These are: (1) general laboratory and the electronics laboratory; (2) logical studies department; (3) manufacturing department; (4) studies department; (5) "Progress" department; (6) application services; (7) technical-commercial services; and (8) The National Computing Center.

In the general and electronics laboratories the new elements to be included in a future line of electronic and electro-mechanical machines are conceived and studied. The logical studies department elaborates functional schemes of projected machines and determines the logic of circuits used for optimum performance and ease in programming, capacity of recording, speed of achievement and safety of operation.

The studies department handles the basic research and development operations for the company. The manufacturing department fulfills its obvious duties.

The "Progress" department looks for new techniques outside Bull which it feels can be applied to the firm's operations. The application services section assumes the respon-



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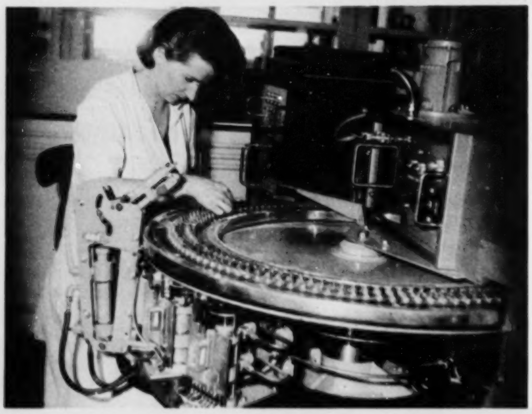
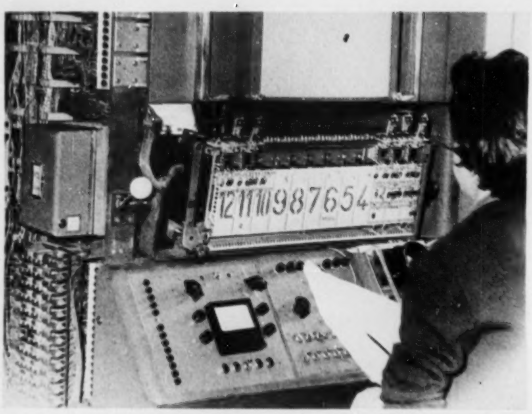


Top row: Left; control machine for drum circuits, and is used to control all elements which enter in the computer in dynamics. Center; control machine for Gamma 3 modules, with close-up of control board. Right; measuring of time on model in Bull laboratories. Bottom row: Left; Bull designed machine for control of diodes provides space for 120 diodes on the ring at any time. Center; dip welding assembly for printed circuits. The design is by Bull, and the mechanism was supplied by Frys Metal Foundries Ltd., Tandem Works, London, and is a Model 3 Fry Flowsolder. Right; testing bench of a supply unit used in the Gamma 60.



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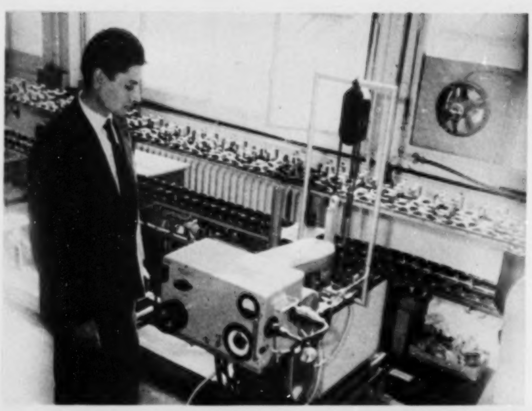


Bull's rule in europe

sibility for the development of maintenance methods.

The National Computing Center includes a studies laboratory for the applications of electronic computers, both for accounting and science. Its activities are especially directed toward the study of programming and the search for mathematical methods adapted to computers.

This global organization started operation in 1931 with 35 employees. This personnel figure jumped to 1,300 in 1948 and at the present time the number is around the 9,000 mark.

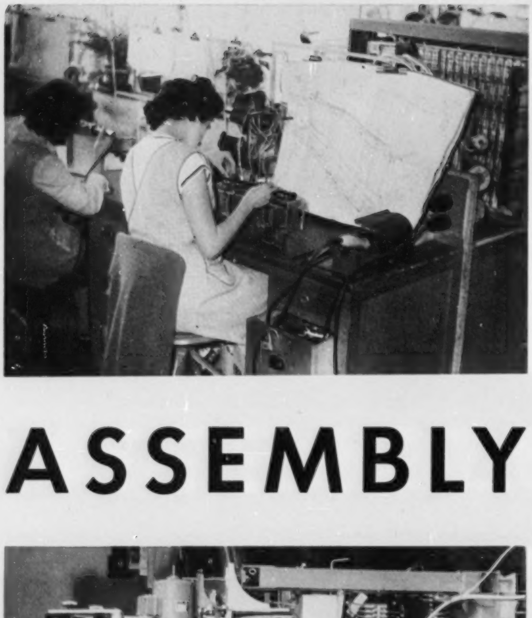
Bull owns about 200 French patents and 550 around the world, however, these figures are changing from month to month.

In 1951, the first Gamma was produced. This was followed in 1955 with a Gamma with high-capacity magnetic drums, in 1957 by a Gamma with an ordering drum, and then in 1959 with the Gamma 60.

Bull's rapid growth can be attributed in part to three engineers who joined the firm between 1948 and 1950. At the time of their arrival, Bull made only punched card equipment. Electronic computers were then not a part of the organization.

In 1950, two of the engineers, Bruno Leclerc and Henri Feissel, made trips to the United States and England. Within one year, with the services of the third engineer, Jean Rollet, these men completed an experimental model called "Gamma."

This was the first step along a path that has carried the firm to the top position among European computer manufacturers.



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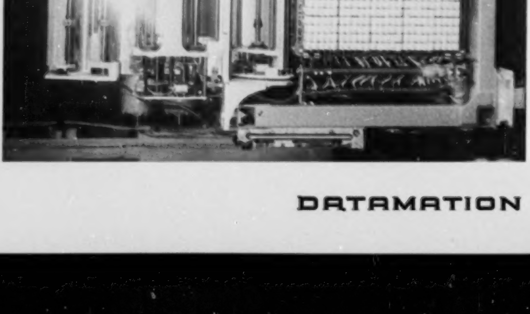
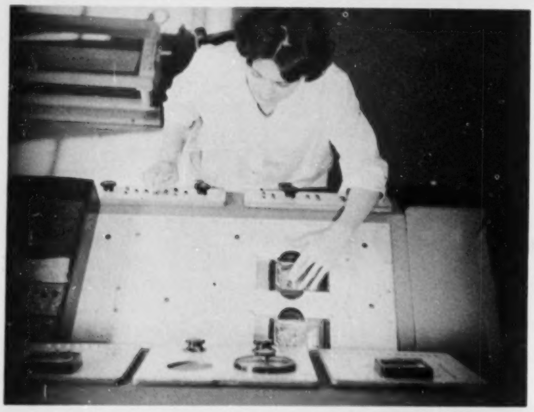
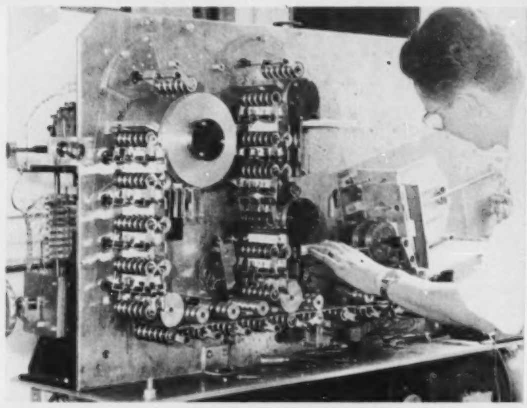


The story of Bull's series 300 data processing system will be told in a forthcoming issue. Produced by continental Europe's largest manufacturer of computers, the 300 series has a reading and punching rate of 300 cards per minute. At the present time there are more than 40 of these systems contracted for outside of France. The system is priced at $160,000.

Bull's rule in europe

Top row: Left; this cabling assembly room at Bull's Paris facility shows a portion of the 2100 people involved in this production procedure. Center; control machine for Gamma 60 logical testing circuits showing operator's task. Right; lab model of a track used in laboratory study built to check the rotating drum of one of the sorting frames in the 900 sorter. Bottom: Left; 300 printer, front view, on the assembly line. Center; reading/writing track of the Gamma 60. Right; test bench for adders used in the 300 series on which additions are made.





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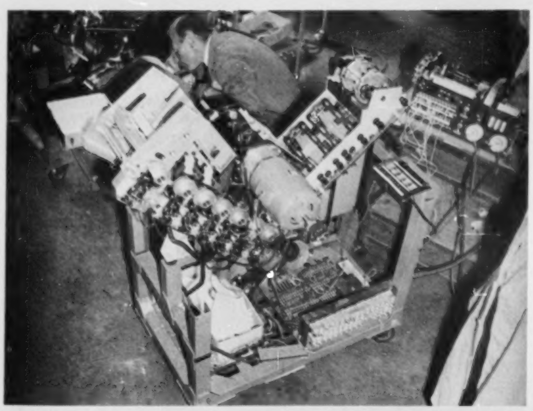

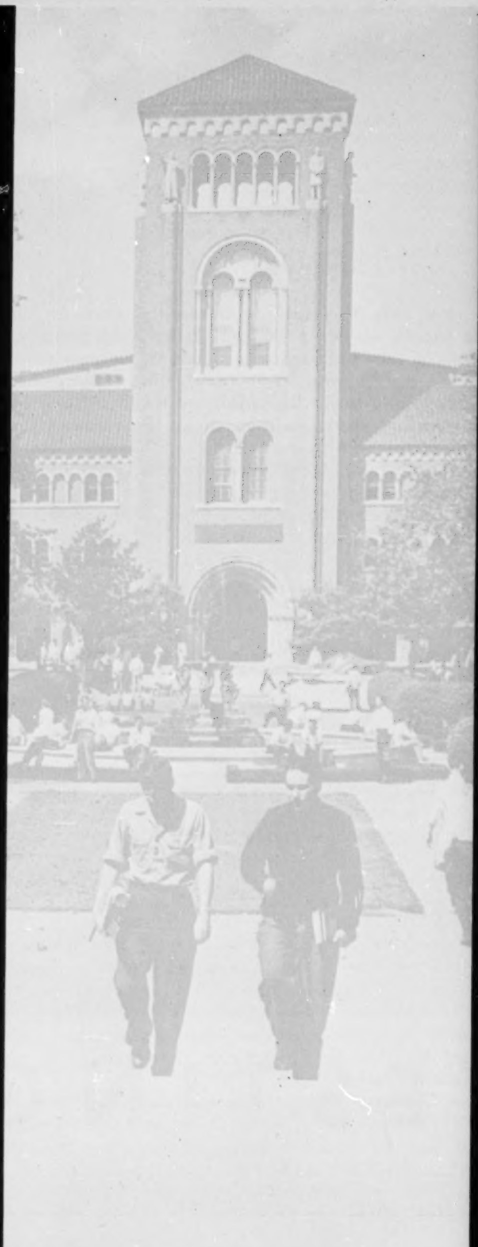

Syn'no-et'ics (sin'no-et' iks), n. (Gr. syn + noe to perceive together) The science treating of the properties of composite systems — con-

In the following paper, the reader is asked to imagine that this is a reprint of an address to an alumni audience in the year 1975 by the president of one of the major universities in the U.S. Following the text of the address is a verbatim transcript of the question-and-answer session that ensued.

COMPUTER-RELATED SCIENCES (SYNNOETICS) AT A UNIVERSITY IN 1975

by LOUIS FEIN, Palo Alto, California

Alumni and Friends:

Last year, we changed the name of our Computer-Related Science Department to the Department of Synnoetics. Since then, we've received many inquiries concerning this department from people who think it is newly formed rather than newly named. Today, I would like to talk to you about synnoetics at our university.

In dealing with the world, man has brought to bear on his problems an arsenal of both his basic unenhanced mental power and the enhanced physical and mental prowess that it produced. Up to about 1940 man, drawing on this arsenal, just about held his own. After that, the problems — some of which were generated by the very use of computers and other enhancers — were getting larger, more complex, more diverse, and more urgent! The penalties for mistakes were more severe. In the fifties and sixties and to this day, the penalty could be the extinction of the human race. Thus, the problem that became the largest, most complex, most diverse, and most urgent, was man's need to use his innate and his enhanced mental power more effectively than hitherto and to somehow further enhance his mental power.

Among man's early feats in this pursuit were the development of digital and analog computers and operations research. And I am sure you all recall that these

were used very successfully in their day. Society has gone a long way since then in providing us with aids for our mental processes and we have reaped the benefits of the consequent increase in our physical and intellectual powers. We've done this chiefly by enlisting the aid of (synnoetic) systems consisting of configurations of people, mechanisms, and automata — machines that exhibit some "mental" characteristics. University scholars have contributed their fair share to these practical advances. But their most important contribution has been the development of an orderly theory of Synnoetics and a coherent curriculum with core courses for it.

Synnoetics is the science of treating of the properties of composite systems — consisting of configurations of people, mechanisms, plant or animal organisms, and automata — whose main attribute is that its ability to invent, to create, and to reason — its "mental" power — is usually greater than the "mental" power of its components. The word Synnoetics, which is derived from the Greek, meaning pooling together the resources of the mind. *Syn* is a latinized form of a Greek prefix meaning "together;" *noetics* is derived from the Greek, meaning "pertaining to the mind or intellect;" *ics* is a suffix that is an accepted form with names of sciences.

You are probably familiar with what the biologists call symbiosis, in which dissimilar plant or animal organisms live in advantageous association with each other. For example lichen is a composite plant formed out of a *fungus* and an *alga* growing together to produce an organism entirely unlike either component. The *fungus* gains nutrient from the *alga:* the *alga* gains an increased supply of water. So in synnoesis. We may have man-computer synnoesis or automaton-automaton synnoesis, or man-man synnoesis. If plant or animal organisms are included in a synnoetic system, we may have man-organism-automaton synnoesis.

The etymology of synnoetics in no way indicates that one is always talking about a man and an automaton as the components of the synnoetic system. However, since this is the most popular system studied now, usage may later confine its meaning to a man-machine synnoetic system.

By using this definition of Synnoetics as a criterion, we have been fairly successful in determining what subject matter is in its realm and what subject matter belongs to other disciplines. Since analog and digital computers are but one species of automata, one branch of Synnoetics is the theory and practice of the design, programming, and application of computers. This branch is called the Computer Sciences. Autonomics is the study of automata, in general, in synnoetic systems. Intellectronics, the implementation of synnoetic systems by electronics, is taught in the Engineering School.

We study the theory and practice of control and communication in synnoetic systems — this branch is called Cybernetics.

In the university community, results of investigations in synnoetics are used to invent processes and generate ideas for solving scholarly problems and attaining scholarly goals in whatever disciplines they are applicable. In this sense, synnoetics is supradisciplinary rather than interdisciplinary. (Subjects like physical chemistry are interdisciplinary in the sense that the *subject matter* of the field overlaps the subject matter of two other disciplines — physics and chemistry. Subjects like logic and mathematics are supradisciplinary, i.e., there are a great number of disciplines in which one can apply their *methods* to the solution of problems.)

Models and simulators of various kinds are very popular for analyzing and synthesizing synnoetic systems, and for solving problems in various university disciplines. Thus, the study of the theory and practice of modeling, simulating, analyzing and synthesizing is in the domain of Synnoetics. A popular model used in studying the functioning of automata is the human being, just as the study of automata has given insights into human functioning. Bionics is the branch of Synnoetics treating of such subjects. Systems theory is the name of the study of generic and analytic and synthetic methods.

Teaching, learning, and the communication of ideas are certainly supradisciplinary scholarly activities. Thus, we study the theory and practice of teaching and teaching aids, of learning and learning aids, and of communication in synnoetic systems. Note that I said that we are concerned with teaching, learning, and communication in synnoetic systems. Thus, in the Department of Synnoetics, they do not study the problems of learning and teaching that have long been in the province of Educational Psychology. Nor do they study natural languages, like the structure, grammar, and syntax of French or German, which are in the province of the Linguistics Department. But, they do study the formal languages used in the communication between components of synnoetic systems. Similar comments may be made about studies in operations research, game theory, information storage, organization and retrieval and automatic programming.

One of the key issues in the design, construction, programming and use of synnoetic systems, is *error*. Specifically, we study the theory and practice of the control, prevention, masking, detection, diagnosis, and correction of errors in the design, construction, programming, and operation of synnoetic systems. The study of error is called Hamartiology, from the Greek *hamartia* meaning to miss the mark.

Finally, we pay considerable attention to the "mental" characteristics of synnoetic systems — artificial intelligence — as well as to their cognitive, self-organizing, and adaptive properties.

The subjects of Synnoetics provide tools and aids which are being used with increasing degrees of success by practitioners in engineering, law, music, chemistry, physics, medicine, psychology, and other disciplines, in ways which were quite unknown even ten years ago. These tools are also useful in the solution of management and control problems in business, industry, labor and government. I am sure you all recall how the famous strike of 1970 was settled when one of our faculty mediators used an automaton to aid both parties in agreeing to what was at once an optimum settlement for both sides.

The reason that we were not satisfied with the former name Computer-Related Sciences, was that the appearance of the word 'computer' was misleading; although we were acutely aware of the public relations value of this word. People ignored the qualifying word 'related' and associated the name exclusively with the computer-sciences — i.e., with the design, programming, and applications of computers, which is now only a small part of the number and variety of subjects we include in Synnoetics. The other names variously used, "Cybernetics," "Information Sciences," "Communication Sciences," etc., had similarly restricted connotations.

curriculum

The Synnoetics Department which is administratively situated in the College of Arts & Sciences, offers an integrated and coordinated syllabus of about fifteen undergraduate courses and twice that number of graduate courses and seminars in both theoretical and applied subjects. (It may be interesting to you to know that there is growing pressure at our University to have two distinct and separate Departments of Synnoetics — one called the Department of Pure Synnoetics and the other called the Department of Applied Synnoetics. Those of you who are

familiar with a similar situation in pure and applied Mathematics at the universities in the United States and in Europe in the nineteen-forties and fifties, will recognize and appreciate the kinds of arguments that are being put forward by those recommending such a split and by those resisting it.)

The names of some of the very interesting undergraduate and graduate courses which were given in the Department of Synnoetics last year in 1974 are:

- Von Neumann Machines and Turing Machines
- Elements of Automatic Programming
- Theory, Design, and Construction of Compilers
- Algorithms; Theory, Design, and Applications
- Foundations of the Science of Models
- The Theory, Design and Application of Non-Numeric Models
- Heuristics
- Self-programming Computers
- Advice Giving – Man to Machine and Machine to Man
- Simulation; Principles and Techniques
- Pattern Recognition and Learning by Automata
- The Grammar, Syntax, and Use of Formal Languages for Communication Between Machine and Machine and Between Man and Machine
- Man-Automaton Systems; Their Organization, Use, and Control
- Problem Solving; an Analysis of the Relationship Between the Problem Solver, the Problem, and the Means for Solution
- Measurements of the Fundamental Characteristics of the Elements of Synnoetic Systems

Our integrated and coordinated curriculum is monitored and controlled by the Curriculum Committee of the Department. This committee is concerned with (a) the timeliness and quality of each course; (b) its relation to other courses given in the Department; (c) its relation to Synnoetics courses given in other departments and schools in the University; and (d) recommending Synnoetics high school curricula for students intending to meet the entrance requirements of the university. This working curriculum committee meets for four hours each month. Each committee member spends another eight hours per month outside the committee room considering these questions. Its chairman devotes full time to this task.

research program

The research program in the Department of Synnoetics is extensive. It is sometimes described as spectacular. I say spectacular because intuition is often misleading in this field, so that many of the results are surprising. One example of an enlightening (and to some people disturbing) result by one of the graduate students in our Ph.D. program is a proof of the theorem that the maximum potential effectiveness of two people working together on certain kinds of abstract problems is at least as great as the maximum potential effectiveness of one of these people working together with an automaton on these problems.

There are between 50 and 100 research projects being pursued at any one time by approximately the same number of research people. Our graduate and undergraduate students, our faculty and visiting faculty members and visiting researchers from industry and from government *all* carry out research programs under the guidance and control of the Academic Research Standards Committee of the Department. The research program is balanced, covering a variety of subjects. Standards of excellence are high. We enjoy this status and can insist on such standards chiefly because we have enough moral and financial support from our own institution, from the industrial and business community, from the government, and from other interested individuals. We are thus in the pleasant position of not having to consider supporting a research program merely because it is a potential source of income. (But, of course, such moral and financial support has an important effect on our program other-than-research – e.g., it also strongly affects our policies on the use of our computing equipment and service staff. Such policies will be mentioned later.)

A random selection of current research projects are:

- A Common Language for Automata and People
- Aids for Extending the Intellect of Man, Automata, and Man-Automata Complexes
- Functional Relationships Between Parameters of a Problem and the Parameters of a Computer Used in the Solution of This Problem
- The Determination of Policies by Automata Playing Games Having Incomplete Theories
- The Dominant Component in Man-Machine Synnoetic Systems
- The Nature of Musical Composition and the Structure of Music
- The Design of Automata to be Used as an Efficient Aid in the Simulation of the Phenomena Studied in Psychiatry
- A Theory of Models

For Synnoeticists not requiring a laboratory, or special equipment, but requiring library services and office facilities, we have a building of well-equipped offices and a highly efficient library and document center with our own retrieval system for material in Synnoetics.

For the "applied" Synnoeticists, we have a four-story building (including a basement) with 10,000 square feet of usable research space on each floor. This laboratory is supplied with test equipment of various kinds and, of course, with a battery of miniaturized computers (in the basement).

About seven million dollars have by now been invested in the facilities for research in "pure" and "applied" Synnoetics.

the degree program

The degree program in Synnoetics is orthodox. There is a prescribed set of required and elective courses for undergraduate "majors." Some undergraduates write theses.

There are two graduate degrees, the MA and the Ph.D. Course, language, thesis, and residence requirements are also orthodox for this graduate program.

Annually, we graduate about 100 AB's; 50 MA's; and 15 Ph.D.'s from the Department of Synnoetics in the School of Arts and Sciences. These graduates are sought by industry, business, the government, universities, and by the computer manufacturers. Except perhaps for the graduates of the Behavioral Sciences Department, these graduates command a higher starting pay than do graduates of any other of our departments or schools.

faculty

Altogether, we have 55 members of the staff for the instructional, research, and degree programs in the Synnoetics Department. This is the equivalent of a full time teaching staff of 20. Aside from teaching undergraduate or graduate courses, sometimes with the aid of the teaching machines which they have programmed, characteristic activities of a faculty member are: writing textbooks and other instructional material incorporating research results, serving on the curriculum committee or research committee; doing research, writing papers for research journals, supervising student research, and serving his professional societies.

The salary range for our staff is between \$9,000 and \$29,000 per year the average is \$22,000 per year. This generous and competitive salary scale is probably the main reason that one seldom finds our faculty engaged

in consulting, even though they are in high demand and despite the fact that we have no administrative ruling whatever on faculty consulting. For another thing, my faculty tells me that most of their consulting opportunities are not professionally satisfying. This is so because — in many instances — consultants are called in to "put out fires" or merely to comment on opinions or decisions already made. Therefore, they leave most of the consulting opportunities to their colleagues at other universities who may need the extra income.

As is the case in every department of our university, the faculty in the Department of Synnoetics is recruited, selected and promoted chiefly on their qualifications as teachers and scholars. It might seem surprising to you that I make a point of this, since you might think that at *most* universities the faculty is recruited, selected, and promoted on the basis of excellence as teachers and scholars. However, such policies are possible only at schools that, like ours, have enough financial and moral support.

Some of our best teachers just teach and do not write. We are pleased to have them with us, as we are pleased to have those who do research and do not teach. Most of the faculty is engaged in some research and some teaching. I must admit that in the past, we insisted that our faculty publish — or else! But that was in the past. As I indicated, promotions are based on the excellence of a man as a teacher or scholar.

Of the 55 staff members, 25 have degrees in Synnoetics either from our university or from the seven other universities that have similar degree programs in Synnoetics; the remaining 30 were trained originally in a variety of other disciplines. They have degrees in engineering, mathematics, linquistics, political science, psychology, physics, biology, neurophysiology, and economics. One of our most brilliant men is also a poet and philosopher.

Most of the 30 were recruited from industry, government, a university faculty or a research center or institute on a university campus where they were already working in a branch of Synnoetics. However, except for the three who came from research centers solely devoted to computing, in not a single one of these cases, were these people working in a group whose primary mission was the pursuit of knowledge in Synnoetics. For example, our former mathematicians, psychologists, and engineers who came from the universities, had appointments in the Mathematics Dept., Psychology Dept., and Engineering Dept. respectively. They were in "foster homes" where their tenure depended on the continued interest of the head of a department whose charter (and budget) was not primarily for Synnoetics; for after all, the charter of the Mathematics Dept. is to concern itself with Mathematics; of the Engineering Dept. with Engineering, etc. I think you can see how under such conditions, we could recruit an excellent faculty from the U.S. and indeed from the whole world, when we offered Synnoeticists a "natural academic home" in the form of a university department devoted exclusively to their field and where their colleagues would have a similar environment and kindred interests.

computing equipment

The Department puts its computer-type equipment to a wide variety of uses in its instructional, research, and degree programs. The equipment is used as a routine mental aid in simple applications such as in calculation; it is also used as an abstract intellectual aid in very complex mathematical and logical applications such as in proving that solutions to certain problems exist; in proving that certain theoretical systems are consistent or complete and even in proving whether or not it can be decided that an assertion is true or false. A wide variety of equipment is available. Some special purpose equipment is used and controlled exclusively by a single group or individual of the Department. One set of general purpose equipment is shared by the University community. The equipment itself is used in allocating priorities automatically. The allocation and operation are monitored and controlled by a central administrative staff of the Computer Equipment Service Center. (This group is what remains of our former Computing Center which once had the assignment and responsibility of planning and carrying out the academic programs we used to have in some branches of Synnoetics.)

Although we have no administrative policy on the matter, neither computer time nor programming time is sold to organizations outside the University in contrast to the practice of some other universities. The chief reason for this is that our faculty feels that there is no important new knowledge to be obtained by such practices.

finances

This year our faculty and research staff salaries will amount to 55 x $22,000 = $1,210,000. Our overhead expenses — including administration, insurance, maintenance of plant, and miscellaneous expenses will be about 75% of this amount or about $905,000 for a total of $2,115,000. Of this amount $450,000 will come from student fees and scholarship and fellowship funds; $200,000 from the support of research done by visitors from industry or government, $1,000,000 in grants and gifts from the government and private foundations, business and industry, and individuals; and $465,000 from endowment income.

Synnoetics and the university at large: curriculum

Some courses are exclusively devoted to a branch of Synnoetics as it bears upon a particular topic — for example, in the Engineering School, there is a course called "Automatic Programming for Engineers." In other courses, the use of a branch of Synnoetics as an aid in the solution of problems in the subject under study is occasionally illustrated and analyzed. Even in courses in modern philosophy, the role of quantitative numeric and non-numeric models (used in the solution of problems in fields ranging from engineering to business to politics) takes major attention. As a matter of fact, some such courses are required for all our undergraduates. We consider that an understanding of the principles of Synnoetics is indispensible to the modern liberally educated man.

Here are a few examples of the courses which were given in the various Departments and Schools of the University last year in 1974:

- Studies in Intuition and Intellect of Synnoetic Systems — Psychology Department
- Patent and Precedence Searches with Computers — Law School
- Computer-Aided Medical Diagnosis and Prescription for Treatment — Medical School
- Synnoetic "Business Executives" — Business School
- Theory of Creative Processes in the Fine Arts — Humanities Department
- Theory of Error and Equipment Reliability — Engineering School
- Design of Analog and Digital Computers — Engineering School
- Simulation in the Behavioral Sciences — Psychology Department
- Machine-Guided Taxonomy in Botany — Botany Department
- The Theory of Graphs and the Organization of Automata — Mathematics Department
- The Effect of Automata on the Legislative and Judicial Process — Law School
- Synnoetics in Modern Society — Sociology Depart-

ment

The Relationships between Models and the Phenomena that are Modelled — Philosophy Department

In general, a course in Synnoetics is given at the School or Department other than the Department of Synnoetics when students are interested in Synnoetics as a tool; but when Synnoetics is studied as a discipline in itself, and as a theory on which sound practice in other fields can be based, it is given in the Department of Synnoetics.

research

Unlike the situation with course work, where there are criteria for deciding whether or not a course is to be given in the Department of Synnoetics, a research project in Synnoetics may with equal justification be done in either the Department of Synnoetics or in the other relevant Departments or Schools. We do not make an issue of this. The research is done in that Department or School chosen by the faculty member, student, or visitor doing the work.

degree program

In both the graduate and undergraduate degree programs, the student selects a major subject and a minor subject. At the university, Synnoetics is the most popular minor subject for the undergraduate and graduate degrees. About twenty percent of all theses done in Departments and Schools other than the Department of Synnoetics are on topics closely allied to Synnoetics.

history

In the past, the university administration and faculty as well as the staff of the Computing Center blundered seriously in many ways. We underestimated the importance of the future role of Synnoetics both as a tool for practitioners in other disciplines and as a discipline in itself. We did not recognize the underlying unity of those subjects we now include in Synnoetics. We over-emphasized the importance of computer design and programming because we were blinded by the huge success of computers as practical tools. The administration was indifferent and some faculty members were hostile. Partially as a result of our attitude and our misjudgments, some of our department heads had to "bootleg" support for scientists working in a branch of Synnoetics.

Under these circumstances our policy on such matters was really not to have a policy at all. However, we were told that a modern university just had to have a computer on campus. So we drifted into accepting a computer from a manufacturer and paid him only 40% of the normal rental in exchange for our meeting his modest requirement of giving one course in numerical analysis and one course in business computer applications. We had one computer enthusiast in our Engineering Department. He was appointed Director of our Computing Center. Since we administrators knew little, and cared less, for this business, we appointed a governing committee for the "Computing Center." The members of the committee represented various interested departments; they met infrequently. Being inexperienced in such matters, they did not really help the Director except occasionally as in adjudicating matters of priority. Since we had no support to cover even the 40% of the normal rental of the computer, we instructed the Director to sell computer and programming time to anyone within or without the University. After we managed to transform our Director from a rather good scholar into a rather poor salesman, he succeeded in selling enough time to pay the rent — with a little to spare. We then saw that we had a good thing going and exploited it accordingly. Our benefactor, the computer manufacturer, objected weakly, but to little avail.

The Director prevailed on some faculty members to use his facility in their instruction and research; also he and his staff were doing some respectable work in language translation and in programming research. Nevertheless, this program did not gain the kind of acceptance by the academic community that he sought. The Director had come to feel that the problems of exploiting a computer to the maximum advantage of scholars in any discipline — computer-oriented research he called it — was as intellectually challenging and stimulating as the problems dealt with by scholars in other disciplines. Thus while it was true that he was using his computing equipment and staff to provide a service as well as a laboratory, he felt that he was also a practitioner in a new discipline which was appropriately called the Computer Sciences. He wanted acknowledgment that Computer Scientists were engaged in legitimate academic scholarly pursuits. He felt that the Computing Center should be the prime mover in identifying and recommending both computer-oriented research topics and courses of instruction to the various Departments and Schools and to the Computing Center. The academic community did not acknowledge that the study of the design, programming and applications of computers constituted a discipline in the classical sense. They considered that the computing activity was little more than a convenient aid for routine calculation. But they did consider his recommendations for computer-oriented research topics and for computer-oriented courses of instruction. We ended up with a variety of courses taught in the Computing Center and in various university departments. The research program was similarly disposed. I suppose that this *ad hoc* program was typical and as good as any of the fifty or so others in the country. We even granted advanced degrees in the Computer Sciences to a few people. The conditions under which these degrees were granted were so informal, so *ad hoc*, that I have forgotten the details. No matter; the program was unsatisfactory. Unfortunately, I am ashamed to admit, we waited many years too long before correcting the situation.

I have never understood why our Director did not recommend a Computer Science Department. I have speculated that, his statements on the matter notwithstanding, perhaps he wasn't too strongly convinced that the Computer Sciences constituted a discipline in the classical sense. And he must have felt intuitively that his Computer Center equipment and staff was destined to be a Service Center and Laboratory only and as such, could not possibly be, for very long the nucleus and spearhead of a curriculum, research and degree program. I also suspect that, feeling neglected, unappreciated, and not very well understood, he must have believed that any gains he could make for the Computing Center, the Computer Sciences, and himself would have to be plotted by roundabout means. He might have felt compelled to try to slip over his ideas on his uninterested administration and on hostile or indifferent colleagues. An informally run Computing Center governed by an *ad hoc* committee would be more suitable to this *modus operandi* than a formally organized Department.

But, in the end all bootlegging operations must go out of business. Either they get caught or the laws and circumstances that fostered them are changed. In trying to operate legitimately under changed circumstances and new laws, the most successful bootlegging operations are hardest hit. For the objectives, procedures, organization, and personnel of the successful bootlegger must be modified too drastically to convert to the new situation.

For a time, our Computing Center Director was a very successful bootlegger. He was hit very hard when circumstances in the university changed, i.e., when the administration and faculty realized the folly of its uninterestedness and shortsightedness.

Now, with hindsight, our mistakes are easy to diagnose. We couldn't possibly have had an integrated and coordinated program when *all* of our academic activity in these fields was designed around the existence of computing equipment. The only problems which the Director of the Computing Center would consider were those amenable to solution by his computer. Actually, he was the administrator of a job shop and its chief salesman soliciting work from prospects inside and outside the university. Consequently, most topics whose study he urged were computer-oriented, i.e., they already had generated or they might generate problems soluble with his computer. Only occasionally did any program include Synnoetic subjects as we now define them and then only when the subject was also computer-oriented. Attention was then intensely concentrated on the exploitation of computing equipment; people did not admit that one could have an excellent university program in Synnoetics — or any program at all — without having computing equipment, even though we had as an example before us an excellent high-energy-physics program and we did not have a cyclotron. And this was a reasonable attitude for people who considered that *all* the topics of what are now part of Synnoetics were computer-oriented. No wonder they could not imagine a program that was not equipment-centered and dominated.

We have by now largely solved these ideological problems. Both we in the University and the community at large now more clearly recognize the role of the University in modern society and the role of Synnoetics in the University and in Society.

As a former historian, I have been impressed with the role and impact of Synnoetics on our society; its impact, it seems to me, is fully as important to us in the latter half of the twentieth century as the Industrial Revolution was to Society of the eighteenth, nineteenth, and early twentieth century. It seems a pity and worse that we were so late in recognizing and acting on this impact. Had the universities and other segments of society oriented and adapted themselves appropriately in the forties or even the fifties, the fruits of the new revolution might have been harvested and enjoyed earlier. We might sooner have enhanced our creative mental powers, and consequently the ability and productivity of diplomats, judges, legislators, poets, teachers, artists, scientists, labor leaders, managers, psychologists, physicians, and others who contribute to the cultural, social, and economic progress and to the security of all of society.

Before closing, I would like to acknowledge the invaluable assistance given me in the preparation of this talk by our former Computer Center Director. He is now a Professor in the Engineering Department where he spends most of his time doing research on electronic components for Synnoetic Systems. ■

ABOUT THE AUTHOR

Dr. Louis Fein is a physicist who turned his attention to computing after taking his Ph.D. degree at Brown University. He led the team that built RAYDAC in 1952 and was founder and president of Computer Control Co. During the course of his work he has instructed at various universities and is now a consultant in Palo Alto, Calif.

The following is a verbatim transcript of questions from the floor and the extemporaneous answers given by the President. Neither the questions nor answers were edited.

QUESTION: Do you think that Department of Synnoetics must have a giant or two in the field in order for its program to excel?

ANSWER: Some administrators, in and out of universities, do not pay much attention to organization. They insist that if they have good people they do not need formal organization to make a program go well. They claim that no organization will work well without competent people. It is common practice for such administrators to appoint *ad hoc* committees to solve miscellaneous problems as they arise. Obviously, there is no necessary relationship between the work and objectives of these committees. Each such committee dissolves when the crisis it was created to handle, is over.

Others incline to paying more attention to organization, arguing that as long as one has good people, a good organization can't hurt: but when one doesn't have the good fortune to have good people always, a program is more likely to go well if such people work in a well-organized way.

I ultimately saw the futility of having scattered, unrelated, *ad hoc* courses. So, as for the Department of Synnoetics, I didn't feel that I should postpone its organization, waiting for the giant to arrive on my campus, and I did not wait. We do have a giant or two now.

QUESTION: Your description of the role of Synnoetics at the university seems to me to be very sensible and appropriate. Did you use a model for solving this problem?

ANSWER: Yes, we did. As a matter of fact, I hinted at it (the model) in the address, when I referred to the pressure to split the Department of Synnoetics at our university into a pure part and an applied part as had been done in some Mathematics Departments. Actually, we modelled the incorporation of the Synnoetics curriculum and research program on our Mathematics program because there are so many correspondences between the two disciplines. They both include a variety of subjects that can be studied as disciplines in themselves in Departments devoted to these disciplines, and furthermore the subjects in the domain of each provide tools for almost all the other disciplines studied in the University. Incidentally, we used the University Library as a model for the ways in which we provide computer equipment and service. Finally, the difficulties that Statisticians had in gaining acceptance by academicians and in incorporating a statistics curriculum and research program into the Universities was a model for our difficulties in attaining similar objectives.

While we are talking about Mathematics and Synnoetics, let me make this additional point: BECAUSE OF THE CORRESPONDENCE BETWEEN THE TWO DISCIPLINES, IF THERE IS NO JUSTIFICATION FOR THE ESTABLISHMENT OF A DEPARTMENT OF SYNNOETICS AT A UNIVERSITY, THEN THERE WAS NEVER A JUSTIFICATION FOR THE ESTABLISHMENT OF A DEPARTMENT OF MATHEMATICS!

QUESTION: Would you elaborate on exactly how your faculty mediator used a computer in settling the 1970 strike?

ANSWER: He simply got both sides first to agree that each would benefit by concentrating attention — not on arguing and finally settling the issues one at a time — but on arguing and finally settling on a program for an automaton. This program would evaluate the thousands of alternative settlements and would recommend a small class of settlements each of which was nearly optimum for both sides. The automaton took only 30 minutes to produce the new contract last year. It would

have taken one year to do this manually and even then it would have been done less exhaustively. Agreeing on the program took one week. Of course, you have already heard that in many areas where people are bargaining or trying to make optimum decisions such as in the World Nations Organization, in the World Court, and in local, federal and world legislative bodies, there is now serious consideration being given to convincing opposing factions to try to agree on a program and having once agreed on it, the contract or legislation or judgment or decision produced with the program would be accepted as optimum for opposing sides. Automata may also be provided to judges and juries to advise them of the effects of such factors as "weight" of evidence on verdicts in civil cases.

QUESTION: Are all faculty members in the University paid as generously as those in the Department of Synnoetics?

ANSWER: The faculty members in the Departments in the School of Arts and Sciences are paid roughly on a uniform scale. The faculty members in other Schools of the University have different scales. As I indicated in my address, each School is separately endowed and supported and each has its own policies.

QUESTION: Please elaborate on the details of the automatic priority scheduling for the shared computer(s).

ANSWER: The shared general-purpose equipment is in the basement. Input, display and output devices are in two dozen or so different locations at the University, each of which may be used as a communication station with the shared equipment which has a large enough capacity to run as many as 20 medium-sized jobs simultaneously. Usually there is no waiting line. If there is a queue, then the automatic priority allocation program indicates to the user when he can expect to get on the equipment. The program makes this allocation on the basis of its priority list, the estimated time to run the program and other data and criteria. Only rarely does a user go to the machine room. When he does, it is to discuss mutual problems with the hardware and programming maintenance crews.

Programming is of course, not the problem it used to be. People state their problems in a language designed especially for the classes of problems generated in the various disciplines. We have languages oriented to political sciences, social sciences, mathematical sciences and seven or eight others. As with natural languages, these discipline-oriented languages seem to be changing continually. Thus, the languages which are used now are named respectively POLOL '72, SOCOL '71, MATHOL '69, etc. POLOL '72 is the 1972 version of the POLitical science Oriented Language, etc. Users feed the computers a statement of their problem in appropriate language. From then on, a compiler automatically takes over, a program is written in a language that the computer can understand and then this program is run.

QUESTION: Why did you wait until 1969 to start the Synnoetics program? Why didn't our university or any other university start on such a curriculum, research, and degree program way back in 1960? Surely then as now, the student demand was large: financing certainly was available from government agencies, private foundations and individuals, from business and industry, and especially from the manufacturers and users of computing equipment. Furthermore, faculty should have been easily available for the same reason that you say you now find it easy to recruit: you provide a natural "academic" home for Synnoetics teachers and scholars now in "foster homes." How do you explain that despite having had the necessary ingredients of a successful undertaking in 1960 – demand (students), ability to supply the demand (faculty) and the ability to obtain financing, – you didn't get around to this undertaking until 1969?

ANSWER: I agree that in 1960, a few universities had the requisites for being able to plan and carry out such a program. In the United States, we did have sufficient student demand, and we could have (with difficulty) recruited faculty and (without difficulty) obtained adequate financing. But I must point out that it does not necessarily follow that if one is merely able to do a job, that this job will be done soon after this ability is acquired. As you know, one must be *ready* and *willing* as well as *able*. In 1960, there was not the readiness and willingness to plan and carry out a coordinated and integrated program in Synnoetics such as the program we and seven other universities now have.

There are three groups whose opinions and judgments are decisive in determining the readiness and willingness of a university to adopt and carry out such a major program. These groups are: a) the public: including the government, industry, labor, consumers, students, and alumni b) the university trustees and administrators, and c) the university faculties. The unreadiness or unwillingness of any one of these three groups to endorse a program can kill the program.

People are usually *willing* to consider a proposed program, if they are convinced that 1) it will help them in performing one of their assigned roles or that 2) it is a "better" program than any alternative. Even if they are willing, they will not pursue a program until they are ready. People are usually ready to pursue a proposed program, if they are convinced that 3) they have or can get the sympathetic understanding and backing of the people in their own organization and of their sponsors, and that 4) the proposed program is high enough on the list of priorities of other tasks that the organization must also perform and that it will be worth more than its cost, and that 5) they have or can easily obtain the resources to plan for and carry out the proposed program.

Against these five criteria, may I elaborate on the statement above "In 1960, there was not the readiness and willingness to plan and carry out a coordinated and integrated program in Synnoetics . . . "

(1) University administrators and faculty were not convinced that any one of the assigned roles of the university would be served by such a program. Few administrators or faculty foresaw the development of the subjects now included in Synnoetics into disciplines. They did not consider that the study of such subjects was the legitimate activity of a university scholar. The arguments pro and con were probably similar to those that raged in university communities prior to incorporation of Medical Schools, of Business Schools, and of Statistics Departments into the academic structure of the university. Some of the most vehement objections came from the so-called purists among the mathematicians who incidentally were also the strongest objectors to incorporating Statistics into university structures. (On the other hand, there were one or two empire builders among Chairmen of Departments of Applied Mathematics who were willing, nay, eager to take on all computer-oriented activity including circuit design.)

(2) The university administrators and faculties thought that alternative programs were "better." Being convinced that computers and Synnoetics (these were confused then as now) would soon lose their glitter and that what was left of their substance would be taken over by technical colleges, vocational schools, etc., administrators and faculty members tolerated the temporary support of Synnoeticists scattered around the departments and schools of the university. They also countenanced computing centers and staff as well as specialized research institutes so long as they made a profit and so long as the university was not committed to their staff, if not to their directors, with tenure contracts.

(3) Even if the university administrators were convinced, they could not count on the sympathetic understanding, agreement, and support of their faculty for a Department of Synnoetics. The faculty members who thought that the computing center should be the main stimulus for scholarship would confine their studies to computer-oriented topics. Not foreseeing the underlying unity and fundamental character of Synnoetics, these computing center people favored an organization and program designed to be a supplement to computing equipment and resisted an organization and program that would have the computing equipment (if it was there at all!) as a supplement to it. Other faculty members in the various departments of the university who were introducing computer-oriented topics into their courses sometimes shared their colleague's shortsightedness and their vested interests as well. Being uncertain about how the introduction of a new integrated program would affect their position in a university that already had some kind of program, they would resist, be indifferent to, or at best counsel caution on such a new program. No wonder the university administrators weren't exactly eager to pursue such a program! Besides this, the "great" universities were not leading the way. They too had computing centers, research institutes, and unconnected, uncoordinated, albeit excellent courses and research projects. If the "great" universities were not farsighted, why should others have been expected to be pioneers? Evidently, the university sponsors (the public et al.) wanted it

that way. Perhaps some administrators were farsighted. But on the record, none was determined enough to overcome the obstacles and pursue such a program. Rather, they and we, strung along with computing center-oriented programs of one kind or another.

(4) The public had given low priority to the traditional role of the university for foreseeing, developing and establishing new disciplines and incorporating them into the university structure. The university trustees and administrators acceded without significant dissent. With the worth of such new programs thus downgraded, universities were discouraged from investing their resources in them.

During the decade of the fifties, the United States was engaged in a running luke-cold war with the U.S.S.R. as now with China. The pressure was on to beat the Russians in military power, and in the exploitation of space. This was a deadly earnest quest for devices to be developed as soon as possible. Government, industry, research establishments, and the universities were enlisted in this expensive quest. To perform this high-priority role, the universities set up institutes, development laboratories (but called research centers, of course) and administered, staffed and housed expensive special projects. Many faculty members acted as consultants to industry engaged in such work. Simultaneously, the universities were engaged in a race with the Soviets to turn out engineers and technicians while the student demand in the United States for an orthodox college education was already straining the limited resources of the universities. And these were indeed limited resources both in plant capacity and in quality of faculty. Many of the best faculty members had been lured to more remunerative employment. For similar reasons, new faculty members were hard to recruit. On the average, the teaching staff in U.S. universities was inadequate.

(5) It was difficult to obtain the resources for incorporating a first-class program into the university structure.

Few university administrators had ever planned and incorporated a new curriculum, research, and degree program into their university. Many of them didn't know how to do it, and were naturally reluctant to try.

While a faculty for a Department of Synnoetics could be recruited for reasons already given, an excellent faculty would probably require higher salaries than the prevailing rate in the university at large. This would be impractical—especially since there was no one of the acknowledged caliber and status of John von Neumann who could be used as a center of attraction.

Synnoetics was relatively new. Few textbooks and little instructional material for an integrated curriculum was available. Writing an integrated and coordinated syllabus would be a formidable task. Some administrators might have been reluctant to pursue such a program while they doubted that they could gather a faculty that could do this kind of preparation well and in a reasonably short time.

I know now that there is an underlying unity among the subjects in the domain of Synnoetics which is a discipline worthy of study by university scholars, and that this discipline is *not* confined to studies of the theory, design, programming, and application of computing equipment. By extending the mental prowess and ability of teachers and scholars in almost all intellectual disciplines, (by augmenting their brains and thereby making them brighter, if you please) Synnoetics is itself the most representative of supradisciplines.

I know now that Computing Centers become service centers just as libraries (are) and that they become laboratories just as chemistry or physics laboratories (are). Since Computing Centers are destined for such roles only, the staff and equipment of the Computing Center just should not be the nucleus of an organization and program for scholarship and instruction. All efforts at the Computing Center should be devoted exclusively to making it a better Service Center and Library. The curriculum and research program must be left to a curriculum committee and a research committee in a duly recognized Department.

The obstacles and difficulties in 1960 were: 1) the tasks to which the universities were already committed were straining their limited resources; they could not take on anything more. 2) Many faculty members and administrators did not consider Synnoetics to be a legitimate academic discipline. They were opposed ideologically. 3) The developing vested interests of computing-center staff and other faculty opposed, or were indifferent to, setting up a Department or School. 4) Very few people prefer the sufferings of being a pioneer to the glories. One stated objection to being the only university with a Synnoetics Department or School is that its graduates who would prefer to remain in university work have nowhere else to go. 5) The Synnoetics faculty would probably be more expensive than the average university faculty because they were doing well financially where they were.

The favorable conditions in 1960 were 1) Finances were available for a university that was ready, willing and able to plan for and set up a Synnoetics Department or School. 2) There would be prestige and glory for the pioneer. It was certain that other universities would follow suit. 3) A faculty was available. 4) There was a large student demand.

This is what I wish we had done 15 years ago in the light of what we know now:

1. I would use all the public relations talent at my command to convince my trustees and sponsors (government, industry, alumni, etc.) of the importance to society of Synnoetics and would urge them to place such a program very high on its priority list for the university.

2. By the sheer force of my personal conviction and my administrative position, I would try to convince the trustees and the faculty that Synnoetics would develop into a discipline and that the university should design around that fact now.

3. As a discipline and as a supradiscipline with such ramifications, I would insist that Synnoetics be treated as we treat other disciplines, such as Mathematics, for example. We organize a Department or School.

Having thus laid the groundwork and having decided in principle what I was going to do, I would then plan and carry out the details of a Synnoetics program in the following order:

4. In the first year, I would select academic, administrative, and service heads of the department (or school) who would spend the year making a "five-year plan" of faculty, financing, curriculum, research program computing equipment, rate of growth, etc. Policies and degree requirements would be established. In fact, they would produce tentative Synnoetics Department catalogs for each of the next five years in as much detail as they could. Research faculty and teaching faculty would be hired for purposes of writing a curriculum and preparing for a research program. I would raise money to finance those items on which agreement had already been reached. (If the vested interests and the shortsighted people were powerful enough to block the introduction of a Department and if also it were difficult to obtain faculty at the going faculty salaries, then I might first set up a separately endowed and supported Graduate School and Research Center in Synnoetics and I would continue to battle from that base.)

5. In the second year, probably only graduate courses and seminars would be given and the research program would start. The undergraduate curriculum and the rest of the graduate curriculum would be in preparation. The financing, faculty, equipment, and facilities plan would continue to be carried out. The Computing Center would be equipped and staffed sufficiently to make it the kind of Service Center and Laboratory planned for during the first year.

6. In the third year, some undergraduate courses would be given, the graduate course and seminar offerings would be enlarged as would the research program.

7. In the fourth and fifth years, the curriculum and research program would be modified and enlarged in accordance with recommendations of curriculum and research committees assigned to monitor and control curriculum and research policies and practices.

By the fourth year, I would expect to have been deluged with exhortations from other university presidents asking for advice on how to set up a Department of Synnoetics. ■

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INVENTORY OF GOVERNMENT COMPUTERS

Manufacturer	Model	on hand FY-'61	estimated on hand FY-'62	change in No.
Bendix	D12	2	2	0
	G15	32	29	− 3
Burroughs	204	3	3	0
	205	17	17	0
	220	11	11	0
	E101	13	10	− 3
	E102	7	7	0
Control Data	160	8	11	+ 3
	1604	5	8	+ 3
Clary	DE60	0	1	+ 1
Digital Equip.	PDP1	0	1	+ 1
	PDP3	0	1	+ 1
Electronic Assoc.	231R	1	1	0
El-Tronics	ALWAC II	1	1	0
	ALWAC III	5	5	0
General Mills	ECS	1	1	0
Honeywell	800	4	8	+ 4
IBM	305(Ramac)	103	116	+13
	650	127	90	−37
	704	18	14	− 4
	705	37	37	0
	709	8	6	− 2
	1401	100	192	+92
	1410	0	4	+ 4
	1620	23	40	+17
	7070	18	25	+ 7
	7080	0	1	+ 1
	7090	30	41	+11
Librascope	ATC	4	5	+ 1
	500	1	1	0
Monroe	Monrobot IV	4	4	0
Autonetics	Recomp II	12	12	0
National Cash Reg.	102	2	2	0
	107	1	1	0
	304	5	7	+ 2
Packard Bell	250	1	1	0
Philco	2000	5	4	− 1
RCA	301	0	17	+17
	501	17	26	+ 9
RemRand	1103	9	8	− 1
	1105	7	9	+ 2
	Unv. SS 80	8	8	0
	Unv. 120	2	2	0
	Unv. F. C. 0	1	1	0
	Unv. F. C. 1	17	16	− 1
	Univac I	6	5	− 1
	Univac II	3	3	0
Royal McBee	LGP30	40	33	− 7
	4000	5	5	0
	9000	0	1	+ 1
Sylvania	9400	0	1	+ 1
Underwood	Elecom 120	2	1	− 1
	Elecom 125	1	1	0

a Bureau of the Budget inventory & projection of

COMPUTING POWER IN THE GOVERNMENT

As the largest, single customer for computing power, the U.S. government recently published an inventory of adp equipment for 43 federal agencies, departments and the armed forces. In a projection of computing equipment installations through June, 1962, the government estimates an annual expenditure of almost half a billion dollars.

With the exclusion of equipment "for military tactical or operational systems and certain other classified uses," estimates of adp operating costs include salaries for personnel involved in dp operations, rentals, contractual costs for service and maintenance, etc.

Since FY 1959, the number of computers in the government has more than doubled and it is anticipated that the total dollar output will have jumped from $250,651,000 in FY 1959 to $497,743,000 by mid-62.

Leading by a healthy margin, the Department of Defense (including Army, Navy, AF, and Office of the Secty. of Defense) accounts for 69% of all government systems (661 main frames out of a total of 971 estimated to be on hand by mid-62 at an annual cost to DOD of $313,601,000 or 63% of the total government expenditure.

Within DOD, the Air Force is first with 305 systems or 46% of the total number of units at a cost of $144,087,000 estimated by June '62. The Army ranks second with 180 units at $81,725,000 annually, and the Navy with 163 computers at an annual cost of $79,678,000.

Other departments with an estimated expenditure over $20,000,000 annually include: Atomic Energy Commission, 90 units, $51,296,000; NASA, 65 units, $26,249,000; Treasury Dept., 25 units, $22,984,000; FAA, 16 units, $22,307,000, and Dept. of Health, Education and Welfare with 23 units, $20,048,000. All of the above are projections for the FY-62.

The dominant supplier in all branches of the government is of course, IBM with 558 units, more than half of the total number of systems or 57.4%. The 1401 is the most extensively used computer with 182 units installed or scheduled for delivery by mid-62. In addition, there

Also included are the following for FY-62: Bureau of Standards Analog—1; Autonetics AV41—1; RCA BIZMAC 1—1; Ballistic Research Labs BRLESC—1; Philco CXPQ—1; Argonne National Labs GEORGE—1; RAND JOHNNIAC—1; RemRand LARC—2; Los Alamos MANIAC II—1; Brookhaven MERLIN—1; Sylvania MOBIDIC—1; U.S. Naval Research Lab NAREC—1; IBM NORC—1; Oak Ridge and Argonne ORACLE—1; Univ. of Illinois ORDVAC—1; Bureau of Standards PILOT—1; Idaho Maryland Mines Corp. READIX—1; Bureau of Standards SEAC —1; and IBM STRETCH—3.

are 116 RAMAC's; 41 7090's, and 37 705's, projected for next year.

Other manufacturers include RemRand with 59 installations; Burroughs, 48; RCA, 43; Royal McBee, 39, Bendix, 31; and Control Data, 19.

It is interesting to note that while the number of computer installations in the government has increased from 414 in 1959 to 971 forecast for FY-62, the percentage of computers purchased has decreased slightly each year in a definite reversal of the national trend.

With wider use of peripheral gear and greater efficiency in operating procedures, the percentage of increase in man-years for government units with computers has gradually diminished.

In the area of shift usage, the number of shifts that a configuration is utilized is not comparable to employee shifts. In this case, a computer shift is estimated on the use of the equipment for 176 hours during a month. On this basis, computers in the government were utilized an average of 1.68 shifts or 295 hours a month during FY 1961.

A major section of the inventory is devoted to the location of computers by office, bureau or command as well as geography. A few examples of concentrated computing power follow:

At the Albuquerque Operations Office of AEC, there are 33 units located throughout the southwest and far west including STRETCH, MANIAC, 3 7090's, 4 1620's, 11 1401's, 3 704's, 1 650, 2 RAMAC's, 2 LGP 30's, 1 G15, 1 Univac 90, 1 CDC 160, 1 Underwood 125, 1 Burroughs E102.

At NASA's Marshall Space Flight Center in Huntsville, Ala., there are 2 7090's, 2 705's, 1 LGP 4000, 10 LGP 30's, 6 205's, 2 Recomp II's, 2 G15's, and 1 Librascope L500.

At the Navy's Bureau of Ships' installations, a wide diversity of equipment may be viewed in varied locations. BuShips' estimate of its computing power on hand by FY-62 includes 1 LARC, 1 Honeywell 800, Philco's CXPQ, 2 704's, 1 705, 1 1410, 1 7090, 1 7070, 2 650's, 6 1401's, 1 RAMAC, 1 Univac II, 2 Univac I's, 1 Univac File Computer, 1 Univac 80, 1 LGP 30, NCR 304, 1 CDC 1604, 1 B205, 2 B220's, 1 E102, 1 Alwac II, 1 Alwac IIIE, 1 G15, and 1 RCA 501.

Equally interesting although f om an obviously different viewpoint is the listing of computing power used by the Strategic Air Command which includes 1 NCR 304, 1 7090, 1 650, and 47 305's.

The Inventory of ADP Equipment in the Federal Government was published in May by the ADP Staff, Office of Management and Organization, Bureau of the Budget, Wash., D.C. ■

COMPUTERS (MAIN FRAMES)

Fiscal Year	Acquired	Used During Year	Removed	On Hand End of Year
1959 (ACT)	*	*	*	414
1960 (ACT)	*	*	*	531
1961 (EST)	328	859	104	755
1962 (EST)	296	1051	80	971

*Data not available.

LEASE VS. PURCHASE

	FY 1959 (ACT)	FY 1960 (ACT)	FY 1961 (EST)	FY 1962 (EST)
Number of Government-owned computers	80*	98	115	119
Number of leased computers	334	433	640	852
Total number of computers on hand	414	531	755	971
Percent of purchased to total number	19.3%	18.5%	15.2%	12.2%

*Approximate.

OPERATING COSTS

Fiscal Year	Costs, ADP Units with Computers Thousands)	Percent Change Over Previous Fiscal Year	Costs, ADP Units With Punched-Card Equipment Only (Thousands)	Percent Change Over Previous Fiscal Year	Total Costs, All ADP Units (Thousands)	Percent Change Over Previous Fiscal Year
1959 (ACT)	$250,651	—	$ 57,374*	—	$308,025*	—
1960 (ACT)	347,826	+38.8	115,973	**	463,799	**
1961 (EST)	442,317	+27.2	111,063	− 4.2	553,380	+19.3
1962 (EST)	497,743	+12.5	98,517	−11.3	596,260	+ 7.7

*Does not include DOD data for units with punched-card equipment only.
**Not applicable.

MANPOWER

Fiscal Year	Man-Years, Units with Computers	Percent Change Over Previous Fiscal Year	Man-Years, Units with Punched-Card Equipment Only	Percent Change Over Previous Fiscal Year	Total Man-Years All ADP Units	Percent Change Over Previous Fiscal Year
1959 (ACT)	24,445	—	8,621*	—	33,066*	—
1960 (ACT)	29,581	+21.0	19,085	**	48,666	**
1961 (EST)	34,252	+15.8	17,957	− 5.9	52,209	+7.2
1962 (EST)	38,198	+11.5	15,817	−11.9	54,015	+3.5

*Does not include DOD data for units with punched-card equipment only.
**Not applicable.

DATA TRANSMISSION AT TAPE SPEEDS . . . 68 mile link fast and costly

An impressive although costly advance in data transmission was announced jointly last month by IBM and the New York Telephone Co. A communications system capable of sending and receiving up to 62,500 characters per second (437,500 bits) between New York City and Poughkeepsie (68 air miles) was demonstrated with commercial availability indicated for similar systems.

Utilizing a newly developed 1945 tape transmission unit coupled to 729 tape drives, data was transmitted over a combination of leased phone lines and microwave links. Although the actual demonstration was accomplished at a speed of 15,000 cps (105,000 bits), the data rate may be increased to 22KC or 41KC per second depending on tape density and with added circuitry to a maximum rate of 62KC. An experimental transmission at the 62KC rate had previously been completed in a cross-country hook-up.

The IBM-Bell Telephone system provides transmission over seven broad bandwidth channels with additional channels included for written and voice communications as well as data verification.

Another commercially available system is the Philco Data Link which operates in message units of 1,024 characters and allows for a transmission rate up to almost 1,000,000 bits per second depending on the transceiver and communications channels available. Rental is $700 per month for two units.

Although other systems such as Collins' Kinetape are also available, installations up to the time of this announcement have operated at about 2400 bits per second (about 100 cards per minute) utilizing available phone lines at a cost ranging from about $1.30 to $4 per month per mile.

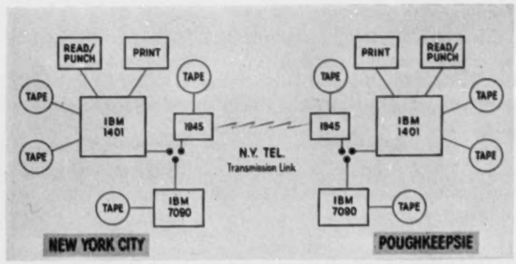
While the speed of the IBM-Bell system is certainly far greater, the cost is substantially higher and in the case of a transcontinen .l link, may well be economically impractical for a large number of potential customers.

For the 68 mile link completed for IBM, the cost is $5,100 per month for the leased phone lines and microwave facilities, nd an additional $2,200 per month for the two 1945s required at each terminal. For the leased lines and microwave, this averages to about $73 per month per mile. It was pointed out however, that the cost of a comparable 3,000 mile link would be reduced to about $45 per month per mile or $135,000 per month which is approximately equivalent to the rental of a RemRand LARC or two 7090s.

The highest single factor in the cost of such a link are the two terminals provided by the phone company. Therefore, the longer the link, the lower the cost per mile per month, and conversely, the shorter the link, the higher the rental cost (the terminals being a stable factor regardless of the size of the link).

Because of the high cost of data transmission, it was suggested that time sharing plans could be arranged as an aid in lowering the cost to a single customer. The technical feasibility and economics of smaller data links connected to a single, master line are presently being studied.

Operating internally for IBM's applied programming division, and also for North American in the Los Angeles area, the 1945 serves as a remote tape reading control unit.



A 1401 in the case of the New York-Poughkeepsie link controls the remote tape unit by means of tones transmitted over a voice frequency channel. Information is transmitted in either or both directions simultaneously. If one location is not receiving, the 1401 may be used as peripheral support for the 7070 or 7090 in New York or the 7080 and 7090 in Poughkeepsie. The object of this internal installation for IBM is to balance the workload between the larger systems and to offer the division's staff of 400 programmers a turn-around time of three hours in having their work transmitted and processed. Formerly, station wagons were used to transport tape and to return with printouts.

In actual operation, on receipt of a go signal generated in the 1945 by a read select command from the 1401, the transmit tape is set in motion. Data recorded on the magnetic tape is sensed by dual-level sensing circuits and transferred as seven parallel bits to the broadband transmission channels.

When receiving, the 1945 accepts the parallel data signals from the broadband channels, amplifies them and enters them into the dp system through the tape adapter unit. Standard tape parity checks are made on incoming data and the read operation is ended in a manner similar to that of local tape reading operation.

The computer can then transfer the data in memory to a local tape unit or to any other output device attached to the system. Transmit and receive function of the 1945 are independent. It is possible to operate in a full duplex mode (provided that a full duplex communications system is used) so that the computer at the sending end is not used for the data transmission operation, and can receive data from the other end or perform its normal functions.

Since the system is still in its early stages of operation, a reliability factor and percentage of down time have not been ascertained.

As is indicated by this development, an essential factor in the future of data transmission is the cost of the system and the phone company will undoubtedly exert the greatest influence in this area. As for speed, the Bell system has announced that they may soon place into operation a new communications system capable of transmitting data at the rate of more than 1½ million bits per second. ■

As a setting for this year's RAND Symposium, the mild Southern California climate was evident for about the time needed to seat the Symposium's 19 participants. From that point, the temperature in Santa Monica took a sudden jump as computer specialists from a vocal and impressive cross-section of the industry selected and ignited a series of volatile, computer-related topics.

For its fourth successive year, the Symposium was held one day prior to the opening of the Western Joint Computer Conference (May 8th). Participants were placed under no restrictions as to selection of topics, direction of discussion, or amount of time to be spent on each subject.

The RAND Symposium has no legislative effect although votes may be taken during the course of discussion to ascertain the group's feeling or lack of it in a particular area. The Symposium is in effect, a meeting of individuals prominent in the industry who spend a day at RAND in the sharing of ideas.

The all-day session was tape recorded, a 156-page manuscript prepared, expurgated by participants and squashed slightly tighter (to meet space requirements) by DATAMATION. Despite the compression, readers will note that in this first presentation on "Computers, Unemployment and Responsibility," a generous number of sprightly kernals are very much in evidence.

Chairman of the session was Robert L. Patrick, a RAND Consultant. Other participants included: Robert Bemer, IBM; Herbert Bright, OEMI; W. Barkley Fritz, Westinghouse; W. M. Carlson, DuPont; J. P. Eckert, RemRand; Douglas Englebart, Stanford Research Institute; Bernard Galler, Univ. of Michigan; Maury Halstead, Naval Electronics Lab; Santo Lanzarotta, IBM; D. D. McCracken, Consultant; Norman Sanders, Boeing; Dura Sweeney, IBM; Herbert M. Teager, M.I.T., and Frank Wagner, North American. Representatives from The RAND Corp. included Paul Armer, Patrick, Fred Gruenberger, Keith Uncapher, and Richard Van Horn.

Opinions expressed do not reflect individual corporate viewpoints and sometimes not even the true feelings of the participants expressing them.

This is the first of a series based on the 1961 Symposium. Next month: a critical profile of ALGOL.

COMPUTERS, UNEMPLOPMENT AND RESPONSIBILITY

the RAND Symposium, part one

GALLER: I think we have two separate problems here. One is what we think the effect of automation and computing is going to be on jobs, and the other is what the public thinks. The next question is whether we, as a profession, should worry about what the public thinks and whether we should worry about educating the public.

PATRICK: During my tenure with General Motors (which lasted some 4½ years), I have seen what automation does at the working level to these guys. This was the classic case of a power play, where the unions made it very difficult for the car companies and the car companies in turn looked for a better way. The found it in terms of the transfer mechanism. Pontiac now makes engines which are not touched by human beings. They start at one end with cast engine blocks and come out at the other end with finished engines. The only human operation along the way is at one point: the bored and honed cylinders are stamped with the over and under sizes of the acceptable pistons and a human being selects the proper piston and sticks it in the hole. Other than that, save a few maintenance men for the entire machine, the seas of people who used to be there cranking on wrenches putting together engines are no longer there. They cut their labor force by 40 to 50%, and what's more, the people that they have left are an entirely different group. They are technicians. This is what the unions are worried about and they're very serious about it because they have a serious unemployment problem.

ECKERT: I talked to a group at General Motors (at their request) about further mechanization of their lines. One thing that held them back was, apparently, just the cost of the computer. This was two years ago, and they were looking for a computer that would have to be three or four times cheaper than we could make at that time. There were no great technical problems; the computer didn't have to be especially large or especially fast, but it had to come in the price range of 10 to 15 thousand dollars instead of 50 to 60 thousand dollars. Now since two or three years have gone by (or maybe two or three years in the future) we have probably gotten to the point where a computer could be built for their figure. They estimate that many such computers could replace hundreds of people. As a general rule of thumb, a computer can't cost more than about 10 thousand dollars per person replaced.

PATRICK: Management's problems go down exponentially when they replace these people.

BEMER: Wherever people are replaced, you find that the men who are left are the better-educated, more highly trained people. The people who are displaced must be trained, and probably the only way to do this job of mass training is to use the selfsame computers to get ourselves

out of the hole. There have been countless examples of people who were rated to have low IQ's and lack of ability to be trained, where with diligent effort their IQ's were apparently raised and they could be trained far beyond the point that was predicted for them. Maybe we had better spend a good share of our time seeing to it that the computers are used to help train these people, educationally — not vocationally.

TEAGER: We seem to be talking in the context of computers and using examples of automation in the automobile industry. I don't think the point has ever been made clearly (or unclearly) whether computers are putting people out of work in the areas they are going into. Nor has it ever been made clear whether the computers are saving people money in the areas in which they are being applied. I think most of us can recite examples of where the computer was going to take over the payroll at some comapny and many little old ladies with green eyeshades were going to be replaced, and two years later it turns out that they have twice as many little old ladies with green eyeshades stuffing things into the computer.

BRIGHT: I would like to call attention to the existence of a congressional subcommittee under Congressman Holland of Pennsylvania. The title of his subcommittee is "Automation" or "Unemployment" or words to that effect.

His subcommittee wrote a report which cites some figures to show that productivity per man has increased and he makes some statements which I think are unsupportable to the effect that, for example, 25% of the clerical jobs have been eliminated in the last five years due to computers. He also makes the statement that within the next five years, four million more office jobs will be eliminated due to computers. You can't say, of course, that his prediction is untrue, but you can show that his history is incorrect.

Let me make a parting shot at industrial automation. Congressman Holland makes a general case for the concept that any increase in productivity is evil. The fact that 40% less people in the coal-mining industry are producing 20% more coal is not necessarily evil. It does imply, of course, that there are some unemployed coal-miners, but this problem is not going to be solved by smashing the machines. Someone in our industry should point out, presumably in public, that the logical extreme of the argument that productivity is evil would be that everyone should be given a pointed stick and told to go out to plant some rice. One of the things that has made Western civilization a good place to live was the continual rise in productivity, which increased the standard of living. There are displacements coming about in the automobile industry and elsewhere which are distressing, but I don't think these people have made a good case for any inherent evil in automation. Twenty years ago, when I was a kid, this was called technocracy, but that faded out. It seems to be coming back again. Somehow I think there is going to have to be an airing of some economic realism. There is a question, to be sure, of who is to do what with the people who are unemployed, but the point I'm making is that there seems now to be a loud and very effective voice in Washington making the point that increased productivity is evil and must be stopped.

GRUENBERGER: We're in the computing business. I'm not speaking to pass the buck, but we ought to make it clear that when you're talking about industrial automation, we're on the wrong end of the stick. The computer is the tool, perhaps the chief tool, of automation, but so are pencils, and the people who make pencils are not going to sit still and let themselves be blamed for unemployment due to automation. I don't think *we* should sit still for it, either. Unemployment due to industrial automation is the concern of the people in automation, not the people in computing.

TEAGER: Haven't there been people displaced in the clerical industries?

GRUENBERGER: Yes, and clerical automation I'll buy. There, indeed, the computer is the heart of the matter.

BEMER: I'd like to give you a chronology of automation. Item 1: The horse is discovered. 2. Horse shoeing is a good business. 3. The automobile is invented. 4. Horse shoeing is a poor business. 5. TV is invented. 6. Westerns are popular. 7. Horse shoeing is a good business . . .

SANDERS: I'd like to ask what is the nature of the jobs that computers will *not* interfere with? We seem to feel that computers can take away jobs, but what is more important, they act to prevent people from acquiring certain jobs. What can we tell people to do? What jobs can we encourage youngsters to go into for which they will have some reasonable expectation that the job will remain stable for the next forty years?

TEAGER: One thing bothers me very much and that's when people of any professional group get up and make statements about subjects about which they know not. One thing I think is clearly the responsibility of people in the computing industry (or profession if you will) and that is before we start to explain away what is going on, we *find out* just what is going on. Through this entire discussion the only concrete fact I heard was something about the automobile workers in General Motors. Before we go on and talk about the displacement of the people in the clerical industries, we ought to find out what is really going on. I am not at all convinced that what was going on with the automobile workers is happening to the same extent or in the same way to clerical workers, but yet I am told that the case of the clerical workers is the only concrete case we have of where people have been displaced as a direct result of the use of a computer. What is the magnitude of this?

BRIGHT: Well, I mentioned before the statement of Congressman Holland that 25% had been displaced in 5 years. I was very curious about this figure so I called the Bureau of Labor Statistics office in New York and got a statistician on the line who was very helpful and he gave me some numbers. I don't have the actual figures at hand but the gist of it is this: at the end of 1960, office worker unemployment was under 4%, well below general unemployment. If we look at the five-year period mentioned by Congressman Holland, far from seeing massive unemployment of office workers, caused by EDP or anything else, we see the number of employed office workers increasing three times as fast as the total of all workers and 4½ times as fast as non-clerical employees.

TEAGER: So the problem that we've been talking about actually doesn't exist!

LANZAROTTA: No sir, you're hiding your head in the sand.

TEAGER: I'm just trying to find out what is going on.

WAGNER: Haven't we been saved by the fact of the tremendous increase in the paper work of the country?

TEAGER: You mean Parkinson's Law has been operating.

WAGNER: To take just one example, if you will look at the annual report of your insurance company, you'll find that in the last couple of decades not only the dollar amount of insurance but even the *number* of policies has gone up by a factor of 15 or so. The increase in the paper work that needs doing has been fantastic.

VAN HORN: All the reports except one that I have read in this area seem to come to this same conclusion. For example, there was a BLS report which reported on a study of 20 companies and in these 20 companies, there were only 9 people laid off as a result of automation and these were all within one company. This particular report

also mentioned the 17% increase in clerical employees and found that for companies that had computers the increase was only around 4 or 5%.

Some of you may have heard Al Zipf of the Bank of America talk the other day. He agreed that they had had to eliminate people, but he said that the type of people being eliminated have an annual turnover rate of 70% and that they actually have a great deal of difficulty in obtaining such people. You might say that computers there have eliminated people, but they were having a difficult time getting those people in the first place. Furthermore, the projections for the future indicate that the number of clerical people is still increasing. There is going to be a need for more people in clerical operations than are coming into the labor force.

CARLSON: This is pretty poor consolation to the man out of work on the streets of Baltimore, though.

BRIGHT: From what we can find out, it appears that this EDP unemployment kick, at least over the past several years, is fictitious.

ECKERT: Why don't we consider a field where technological unemployment has already taken place, namely in farming. Over the past 35 years the number of people employed in farming has gone down from something like 15 million to 6 million.

PATRICK: Of course, there you're worrying about men's muscles and not their minds.

ECKERT: In this same period, the number of clerical workers has gone from perhaps 5 million to over 15 million. It looks like the clerical labor pool has just about absorbed what the farms lost . . . In a big insurance company the turnover in clerical workers can be as high as 80 or 90% per year. Some of them get married but a lot of them just drift around. In farming you probably have price support as a result of all this.

TEAGER: But the issue there is clear-cut. In farming, there is a limit as to what you want to do: you want to raise a crop. Paper, on the other hand, seems to have a life of its own. You may combine forms, you may put a computer in to do the work, but now you find that there are 16 other things that the company would like to do and you require those people again.

ECKERT: But on the farm at one time this thing went the other way. There was a time when we didn't have 15 million people on the farm. It built up to a peak and then fell. Just because we haven't reached the peak in this paper work thing doesn't mean that there isn't a peak. Presumably, we will come down and the question then is, "Where will these people go?" They seem to have gone from the farm into paper work.

SANDERS: Of course, automation hasn't been with us very long.

ECKERT: In a certain sense. In the farm it's been with us a long time.

PATRICK: Define what you mean by automation.

ECKERT: The cotton gin was an example of automation. It replaced a lot of people.

PATRICK: In that sense, it's been here since the start of man.

SANDERS: I think we're talking about the impact of computers. The first one started working around 1949. Maybe that was the end of man.

PATRICK: Desk calculators have been around a lot longer than that and they've eliminated a lot of pencils and paper.

LANZAROTTA: But we're talking about computers and information processing.

TEAGER: What about punched cards? They've been around for a long time.

ECKERT: I think there's a point we're overlooking here. We started out talking about automation and then shifted to computers. I don't think we really deserve all the rocks that are being thrown at automation by the labor unions today. Since computers are so intimately associated with automation, we're getting these rocks on the rebound and computers can't vote.

CARLSON: There are already forces fully in motion which will bring to the automation scene a desire for congressional action, public control, public subsidy, and public correction. These will be demanded for a situation much like the one we have seen in the farm area. We can't afford to sit around and wait until it happens. We have to do something about it now.

ARMER: And you can't simply say that it isn't there or try to draw a fine line between computing and automation.

SANDERS: And we shouldn't have to be on the defensive.

HALSTEAD: But the deal with the farms is a little bit different. There's only so much we can eat; when it comes to enjoying the fruits of production, there is no real upper limit.

CARLSON: If somebody legislates it, it will be there.

ECKERT: In the Detroit situation, the thing you were trying to automate was very expensive and it paid to use automation techniques. We have an area in Remington-Rand where we would like to automate and it doesn't pay; namely, in the assembly of a typewriter. The individual parts that go into a typewriter can be made by automatic machines; assembling all these little parts into a typewriter is still largely a manual operation. The only solution Remington-Rand has been able to find is to have much of our typewriter manufacture done overseas. The only hope is in an assembling machine that can be programmed to stand the model changes from year to year.

CARLSON: I hope your president is ready to testify before congress.

BRIGHT: It seems to me that in the last decade or so, there has been a reversal in this country of a trend that existed throughout our entire history up to that time, namely, a continuous increase in the productivity of the work force. We were able to make things better, faster, more efficiently, and in many cases cheaper than the rest of the world. Our automobile industry is an example of what was giving everyone else in the world a very bad time. Since the war, a combination of factors, but mainly the union squeeze on labor costs, has brought us to the point where the Europeans are taking a lot of this business away from us. In other words, the Europeans have continued to increase the productivity per worker. In this country, various factors like the union demands for featherbedding that we hear about, have added up to what seems like a concentrated effort to reduce the apparent efficiency of the work force. As I see it, then, the solution to our problem is to tackle the cause rather than to try to smash the machines. We ought to make an attempt in this country to again increase productivity to the point where we are competitive with the rest of the world.

ECKERT: You know what Eli Whitney said about this, don't you? "Keep your cotton-pickin' fingers off my gin."

WAGNER: Does anyone here know what has happened to the curve showing the average length of the work week over the years? Has it continued to go down? It seems to me in the last 20 years or so it has flattened out. Up to about 1940, you would see this curve displayed showing a continual decline. When the war came along that decline stopped, of course, and it seems to me that since the war it has not continued the downward trend.

BEMER: I hope not.

WAGNER: Well, maybe that's a good thing.

ARMER: In fact, isn't it true that in places like the automobile industry, after they've had a layoff, that they'll work their existing staff overtime rather than hire new people?

PATRICK: Yes. The management is trying to flatten these peaks and valleys.

WAGNER: And it's not improbable that the information processing sciences (through AFIPS) could assist in this.

TEAGER: I think there's a real danger in taking professional societies and trying to make a national association of manufacturers out of them.

CARLSON: I beg your pardon. We're not talking about a professional society. AFIPS is a society of societies organized to represent the computing sciences and the information processing fraternity, wherever they may be, on a national and an international basis to present their case to the public. This is written into its charter.

BRIGHT: I'd like to move that we support Teager's position that information processing people not try to take a stand in areas where they are not competent. One such area is industrial automation. I realize that not all those here agree with that position, but I would like to see a vote taken on it.

LANZAROTTA: I don't necessarily disagree with your point, Herb, but I'd like to point out that it is going to be extremely difficult to maintain this distinction when companies like IBM and RCA and Ramo-Wooldridge, who are now identified with information processing, become quite active in industrial process control. People are going to question whether this is a straw distinction. They are going to point out that many of these companies are as much interested in the one field as the other.

BRIGHT: My main point is that I would not like to see the *Communications* of the ACM turn into another *Bulletin of the Atomic Scientists.* I don't want to see us get involved in the social implications of things that we don't understand very well.

CARLSON: It's charitable of you to put the ACM and AFIPS on a comparable basis, but that's not the point. Sandy's point concerns itself with the question, "What do we do if the automatic control committee joins AFIPS?" which is a highly probable event.

BRIGHT: Then we just might have some of the competence available.

ARMER: I just object to trying to draw this line between computing and automation. Supposing you have a data processing system which replaces a man who is both a stock picker and a record keeper. Let's say that we have an inventory control system which not only keeps records of stock on hand and decides when and what to order, but also picks the items from the bins, moves them about, packages them and labels them. Is that computing or automation? How do you draw the line?

GALLER: It seems to me that it goes without saying that AFIPS should not deal in areas where it is not competent, and the effect of Herb's motion is to define *this* area as one in which we think it is not competent.

BRIGHT: The present membership of AFIPS is not competent in the area of industrial automation.

LANZAROTTA: The effect of the motion, then, is rather insulting to the ruling group in AFIPS.

TEAGER: But there is a real danger, since groups which assume power tend to assume competence in many areas.

BRIGHT: I would suggest that it be resolved that AFIPS not speak publicly on the subject of industrial automation until it is competent to do so. ■

(Editor's Note: The outcome of a subsequent vote taken on this resolution was that the Symposium (as a body) should not make recommendations to AFIPS.)

MERGERS & new firms in DP

■ United Research Inc. has formed a new data systems division, under the direction of Dr. J. D. Grandine. The new division, which resulted from the combining of staff and activities of the Broadview Intelligence Systems Division with those of Kennett Computer Consultants, Inc., will emphasize analysis and programming of large-scale systems for general-purpose digital computer implementation.

CIRCLE 100 ON READER CARD

■ Computer Control Company, Inc., has signed a long-term agreement with Stone Laboratories, Inc., for the joint marketing and manufacture of Stone's new Tellertron systems for application in savings banks.

CIRCLE 102 ON READER CARD

■ Infonetics Corp. was recently formed to design, manufacture and market peripheral equipment devices for dp systems. The company's first products are tape perforators and digital readout devices, which will be followed by tape readers, page printers etc. They are engaged in manufacturing and sub-systems engineering for other companies in the dp field.

CIRCLE 103 ON READER CARD

■ National Computer Analysts, Inc. has expanded to include new facilities at Route 206 Center, Princeton, N.J., for its staff of programmer-analysts. The new company is engaged in providing a complete range of consulting services to manufacturers and users of computing equipment.

CIRCLE 104 ON READER CARD

■ Consulting Associates, Inc., Hyatsville, Md. is a new firm specializing in communications and data processing consultant services. President of the company is Causton H. Robinson and the directors are Stephen P. Tyma, George W. Lerch and Walter Novotsky.

CIRCLE 105 ON READER CARD

■ The first of a series of microwave linked computer centers to handle business data processing for Boston and other New England areas has been initiated by Production Systems, Inc., a new industrial consultant firm in Boston.

Computer time for the first center will be sold on a GE 225 for payroll preparation, inventory control, procedures-analysis, cost and scheduling, etc. In addition, the firm plans to offer customers a complete systems package.

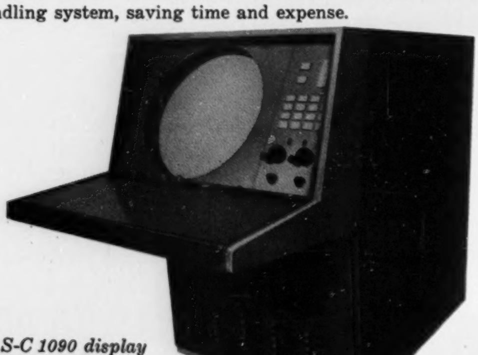
First "off-the-shelf" high resolution display for low cost computer monitoring

General Dynamics/Electronics' new S-C 1090 is the first "off-the-shelf" computer display featuring high character legibility on a large CRT screen. The S-C 1090 incorporates an improved 19-inch CHARACTRON® Shaped-Beam Tube and is capable of displaying 1000 flicker-free, high-resolution characters simultaneously anywhere on the tube face. Thirty thousand or more characters per second may be displayed with extreme brightness and contrast.

MOST VERSATILE DISPLAY. The S-C 1090, operating either on-line or off-line, is designed to monitor digital computer systems and present data for decision or information purposes. Alphanumeric or symbolic characters, and vectors may be presented singly or in combination.

Maximum flexibility for various applications has been provided by a number of special modular optional features for the S-C 1090 display which include:

1. *Internal Test Pattern Generator*—permits complete set up and calibration without tying up the computer or data handling system, saving time and expense.



The S-C 1090 display is compact, offers full 19-inch screen

2. *Vector Generator*—capable of drawing straight lines between points on the tube for graphic presentations.
3. *Format Generator*—reduces the S-C 1090's input requirements and doubles display rate from computer.
4. *Input Register*—provides console with buffer storage for position and character selection information.
5. *Offset & Expansion*—can enlarge any segment of tube screen to full screen size for more detailed view.
6. *Category and Feature Select*—allows selection of information for display without computer intervention.

SUPERIOR CHARACTER FORMATION. The CHARACTRON tube's unique method of shaped-beam character formation offers proven advantages over less precise line-segment, dot, or scan character forming techniques.

Symbols and characters are obtained by extruding electron beams through stencilled openings in a metal disc called the matrix. After passing through the matrix, the character-shaped beam is directed to an appropriate spot on the tube face. Most matrix have 64 characters.

COMPACT DESIGN. The S-C 1090 is a compact unit measuring 32 inches in width, 45 inches in height, by 66 inches in length. The unit's low silhouette allows operators to actually look over the top of the console for simultaneous viewing of the tube screen and projected large screen displays.

S-C 1090 APPLICATIONS. The S-C 1090 is capable of tabular, situation or graphical presentations and can be used in a wide range of computer intervention, monitoring and retrieval jobs. It is suitable for laboratory, simulation, Air Traffic Control and surveillance applications.

For additional information on the S-C 1090 Direct View Display or other General Dynamics/Electronics readout and display systems, write General Dynamics/Electronics, Information Technology Division, Dept. B-53, P.O. Box 2449, San Diego 12, Calif.

GD

GENERAL DYNAMICS | ELECTRONICS

DATAMATION

NEWS BRIEFS

CDC, NCR & TRW ANNOUNCE '61 SALES

Control Data Corp. reports a 100 per cent increase in sales for the fiscal year ended June 30th, 1961 over the previous year. Sales were $19,783,000 and net earnings $842,000. For FY 1960, sales were $9,665,290 with net earnings of $551,686. For additional funds to finance its operations a $10 million revolving credit agreement has been arranged with a group of banks and a 3 for 1 stock split authorized.

The National Cash Register Co. has set a new sales and service record for the first half of 1961, totaling $238,846,485, a 16% increase over the previous 1960 record. Since installations and orders for NCR dp equipment now exceed $100,000,000 the company is expanding its marketing and service organizations. Also, additions to NCR's present network of six dp centers are planned.

Although no specific figures are provided, Thompson Ramo Wooldridge's computing systems sales in 1961 are thus far reported 300 per cent above the comparable period in 1960. Computer contracts for this year are largely in the process control field. The TRW 330 is the newest addition to the firm's line of industrial control systems. Also ready for application is the ANUYK, a stored logic computer designed for military sales.

C-E-I-R RAISES $5,000,000 PLUS

A broad expansion of financing for C-E-I-R has been announced with more than $3 million worth of securities recently purchased by Investors Variable Payment Fund, Inc., Minn. Within the last 15 months C-E-I-R also raised another $2,580,000 from stock sales, and during this period has completed six mergers with American Research Bureau (including ARB Surveys); Facts Consolidated; Data-Tech Corp.; Computer Services, Inc.; Engleman & Co., Inc. and General Analysis.

USC ADDS 800 & SS80

The University of Southern California's Computer Center is now operating with a Univac SS 80 and a Honeywell 800. The SS 80 has been working one eight-hour shift a day. The 800 was installed this month. Both Honeywell and RemRand will each have ground floor space for their computer equipment and offices. The university will have both offices and classrooms in the center. Dr. Robert R. Brown, formerly of IBM, has been appointed director of the computer sciences laboratory and associate professor of mathematics at SC.

Business and engineering classes in the use of computers will be expanded because of the new equipment and courses are planned in the application of computers in medicine, public administration, social work, chemistry and physics. A library of computer knowledge will also be part of the new computer sciences laboratory.

U.S. PLANNERS TO BOOST IFIPS CONGRESS

Dr. E. L. Harder (seated at head of table) has been appointed chairman of the attending U.S. committee at IFIPS, scheduled for Aug. 27- Sept. 1, 1962 in Munich, Germany. Dr. Harder, vice president of the AIEE, is manager of advanced systems engineering at Westinghouse. In addition to coordinating U.S. efforts for the Congress, he heads the U.S. program committee which will do preliminary screening of contributed papers. Also seen in the photo (l to r) is Harder's executive committee: Warner Leuter of RemRand; Walter Bauer of TRW; Charles Adams, in charge of publicity; IBM's Warner Buchholz, in charge of travel arrangements, and Dr. D.L. Thomsen, Jr., also of IBM in charge of U.S. exhibits. Isaac Auerbach, IFIPS chairman, arrived at the meeting soon after the photograph was taken.

IBM UNVEILS WALNUT FOR IR

IBM has demonstrated a new IR system that is able to retrieve any one of almost one million images from a file center within five seconds. Although not commercially available, the system has been developed for the Central Intelligence Agency.

A tiny image of the document is photographically transfered to an IBM card so that the document can be viewed on a screen or printed out without removing it from storage. The system has been named WALNUT.

Each bin, or document file, contains 200 plastic cells of 50 film strips each, a total of 990,000 images. The total WALNUT system can accommodate more than 100 document files.

There was no delivery date or sales price released at the recent demonstration.

ELECTRICAL STANDARDS EFFORT UNDERWAY

Approval of a technical committee to develop international standards for electrical characteristics of digital computers, with the secretariat awarded to the United States, marked the business session of the recent meeting of the International Electrotechnical Commission at Interlaken, Switzerland. Scheduled to have its first organ-

News Briefs . . .

izational meeting in London during November, the committee has been charged with standards work relating to graphical symbols, input-output media involving magnetic tape and the levels of current, voltage and impedance for data transmission.

MIT USES 709 FOR BOOK EDITING

A 709, a special typewriter and a standard photographic typesetting machine have been teamed up by two scientists at MIT for the rapid editing and reproduction of books and other documents. With this system, a draft of a book may be typed on a paper tape punching typewriter and the 709 subsequently averages about 20 seconds per page when editing material.

As examples of the editing instructions included in the computer programs, the following are provided: replace "special typewriter" by "tape punching typewriter" in sentence. Insert "other" before "document" in the second sentence. These instructions are decoded by a program similar to those used extensively in other problems where instructions are provided in stylized but easily understood English.

• At a recent Bendix G-15 users meeting in Denver, a survey of more than 50 users posed the query: "Do you think your management is taking full advantage of the potential of the computers now at work within your organization?"

Almost without exception the answer was "No!" The majority of reasons centered about the lack of understanding by management as to what computers can and should do, and the lack of sufficient programming manpower for the investigation of new applications.

• Honeywell's EDP division has awarded two additional projects to Computer Usage Co. CUC is to assist Honeywell in designing COBOL compilers for the H-400 and 800 and to prepare a programming system to facilitate the writing of compilers.

Computer Usage has recently completed for Honeywell an algebraic Compiler for the 800, a simulator of the 650 on the 800 and Card ARGUS, a symbolic assembly program for card-only 800's.

• A $2 million Univac 490 real-time system has been purchased by the Bowery Savings Bank in N.Y.C. The first of its kind in the banking indus-

How to convert perforated to magnetic tape at a reasonable cost (NOW)

Tally's new solid state Model 1433 Paper-to-Magnetic Tape Converter is not 10 years ahead of its time. You can solve today's media conversion problems with both integrity and economy.

Normally, input and output data are completely identical in content. The output record is a bit for bit image of input data. A universal code conversion feature is, however, available.

Without changes or adjustments, the Tally converter will accept paper, foil, or plastic tapes in widths varying from 5 through 8 levels. It writes data on magnetic tape compatible with IBM 727, 729 Mod 1, and Remington Rand computer formats. Other formats are also available.

Complete in itself, the system includes a 120 cps paper tape reader, a Potter magnetic tape handler, and necessary electronics. Price of the Model 1433 begins at $26,500. Delivery is currently 120 days. More information can be obtained from your Tally engineering representative or by writing

TALLY
REGISTER CORPORATION
1310 Mercer Street • Seattle, Washington
MAin 4-0760
OFFICES IN ALL MAJOR CITIES

CIRCLE 19 ON READER CARD

News Briefs . . .

try, the system will handle up to 800,000 accounts and can be expanded to handle 2,000,000 accounts. Each teller at all five of the bank's offices, will use a Univac Unisaver teller set to transmit deposit and withdrawal information to the centralized computer. Records of all depositors' accounts will be stored in the system. Date of installation is March, 1963.

• The Farrington Manufacturing Co. is producing optical scanners at the rate of one a week, to meet a backlog of orders, which will be delivered to such companies as Northwestern Mutual Life Insurance Co., Milwaukee; Atlantic Refining Co., Phila. and Time, Inc., Chicago.

• Royal McBee Corp. and Staples High School in Connecticut, are jointly conducting a project for teaching the technique of programming and operating an electronic computer to 16 high school students. This project is aimed at testing the abilities of secondary school students to learn the fundamentals of electronic computation. An LGP-30 is used for the project.

• A $68,000 award was given to the Applied Research Laboratory of Sylvania Electric Products, Inc., by the Rome Air Development Center for the study of dynamic programming techniques. Used as inputs in inventory management, such information as ordering costs, statistical distribution of demand, warehouse capacity and distribution of lead times are used for the construction of mathematical models.

• Over 700 requests have been filled for Computer Usage's 1401 memory print program which is being offered without charge. It is available for any 1401 with 1.4 to 16K memory. All memory is printed except the first 80 positions which comprise the card read area. The location of each character is identified separately.

CIRCLE 106 ON READER CARD

• Analog computers are now being used to study several problems concerning replenishing the vast natural water storage basin underlying the L. A. County area, with fresh water transportated from Northern Calif. Based on data accumulated by the So. Calif. Dept. of Water Resources, the analog units from Electronic Associates have been able to simulate a mathematical model of the basin.

ON LINE . . . and off

by GOMER WHEATLEY

Anyone knows it's easier (and maybe cheaper) to de-bug a program if you're sitting at the console. However, the cost accountants must be happy, so we have

"operating systems!"

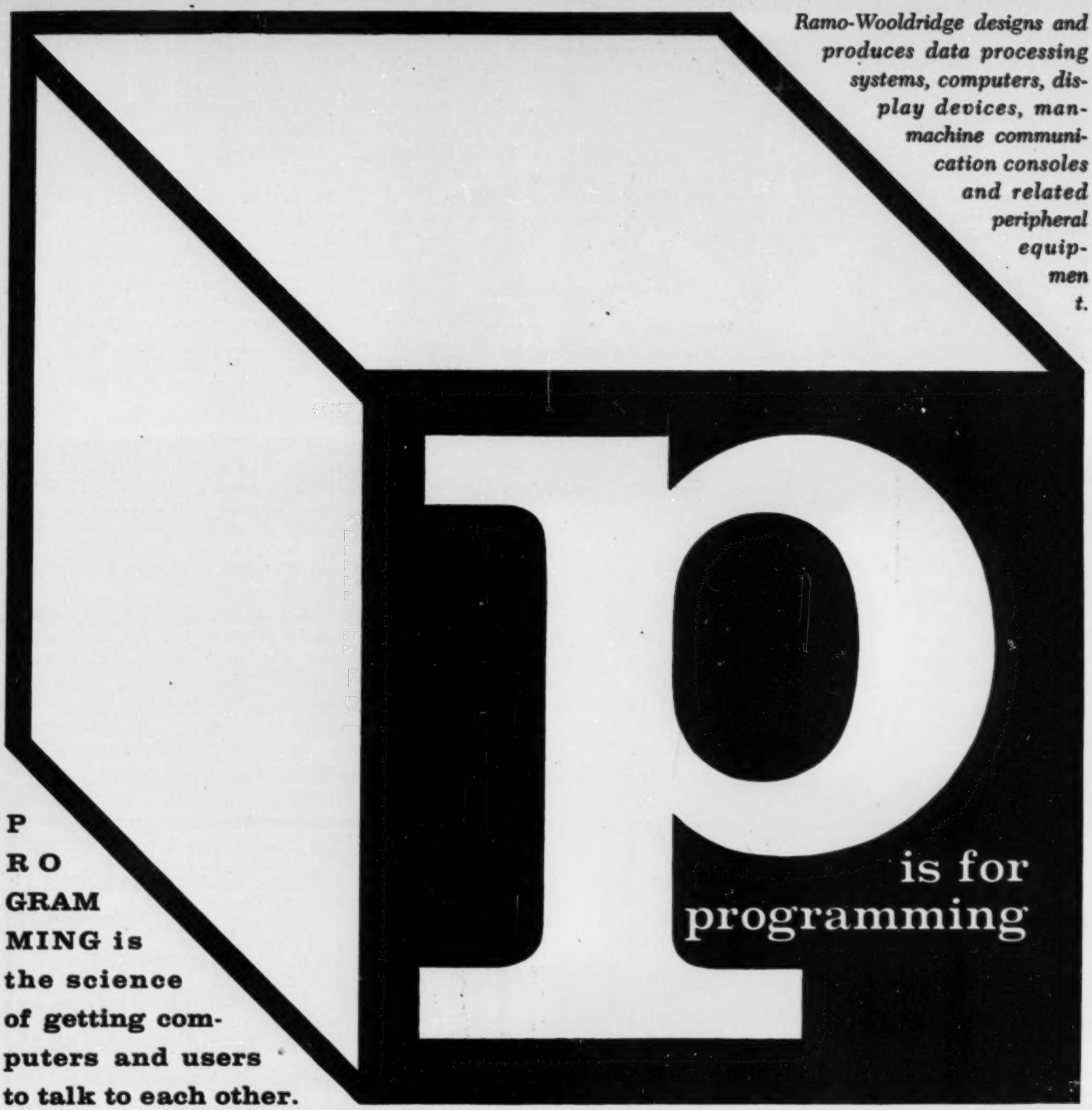
Their principles of operation are simple enough:

1. you're stuck with it, whether you like it or not
The rules stated that everyone was to use THE SYSTEM. Manuals and forms were distributed to the programmers; operators went to school and were trained to respond to a set sequence of lights and printed messages. If one's program tried to get outside THE SYSTEM, the lights and messages would differ from those expected, and the operator dutifully bumped the job off the machine. My unfortunate friend had a program which was obviously too large to share memory with THE SYSTEM; under the standing rules his job simply would never get done. His problem was resolved by a stroke of genius: He wrote a set of subroutines for his program which simulated to the operator the lights and messages generated by a properly used SYSTEM. This worked beautifully until the day they updated THE SYSTEM.

2. turn-around time is never what they say
Service had gotten so bad it was going to take 26 months beyond the deadline to get my program out. I had already abandoned THE SYSTEM, and was doing my work on a smaller machine which I was allowed to run by myself. Then along came a memo saying I could get my jobs back in ½ a day. Had they junked THE SYSTEM? Unlikely. Maybe they bought new motor skooters for the couriers? I was naturally suspicious, but was willing to give it a try. While I was taping up my card boxes, containing a duplicate (never trust anybody) of my master deck, the courier arrived with an envelope. The results of my assembly were back before I had sent the job out! Apparently an ancient output had been sitting around on mag tape, and someone forgot the account card on another job, which brought my results banging out at the end. Furthermore, they charged my project for the gratuitous output.

3. dinky jobs have low priority
Poor Sam could never make his jobs run more than 45 seconds. They were terribly important to him, and to the project on which he was working, but so unimpressively small that they usually hung around for days until all the big jobs got done. During one of his longer waits, Sam developed a program called SPJ: Sam's Priority Jumper, a 1600-card deck which goes in front of your own—usually dinky—program. SPJ runs a cool 17 minutes and produces miles of paper. At the tail end of it all is your own 10 lines of vital printout. The scheme was very successful—all of Sam's office-mates, and all of their friends began to use it. Finally the computer was so overburdened that the company was forced to buy a larger and faster machine. With all the computer time available on the new machine, there was, of course, no further need for SPJ, and it simply dropped out of use. With no more SPJ's to run, the new machine utilization turned out to be a small fraction of what was expected. The computer manufacturer is rewriting his advertising. ■

Ramo-Wooldridge designs and produces data processing systems, computers, display devices, man-machine communication consoles and related peripheral equipment.



PROGRAMMING is the science of getting computers and users to talk to each other.

At Ramo-Wooldridge, programming is considered to be a science. Understanding the problem, the user's needs, and the hardware—in their fundamental aspects—is the starting point for a scientific programmer. Mere coding is not his job.

Ramo-Wooldridge believes that the major advances in computer design over the next ten years (call them "breakthroughs" if you will) are going to result from innovations in software design as much as from new hardware concepts. R-W's "back to fundamentals" approach has brought national distinction to its programming staff and won a position of leadership in such fields as

- *Stored Logic Computer Design*
- *Multi-Computer Installations*
- *Large-Scale Information System Design*
- *Man-Machine Communications Techniques*

If you have three or more years of professional experience, you are invited to inquire about immediate openings on Ramo-Wooldridge's expanding programming staff. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

Address inquiries to
Mr. R. J. Kremple at

RAMO-WOOLDRIDGE
A DIVISION OF
Thompson Ramo Wooldridge Inc.

8433 FALLBROOK AVENUE, CANOGA PARK, CALIFORNIA

CIRCLE 72 ON READER CARD

1961 EASTERN JOINT

242 papers submitted, 31 selected

A record 212 papers, dealing with hardware and software leading toward "Computers — Key to Total Systems Control," have been submitted to the 1961 Eastern Joint Computer Conference to be held Dec. 12-14 at the Sheraton Park Hotel, Washington, D.C.

In the selection of papers, program committee chairman Bruce G. Oldfield (IBM Federal Systems) feels that submissions were subjected to one of the most thorough reviews in conference history.

Ninety-four reviewers and program committee members, representing 24 organizations, including six manufacturers and eight government agencies, were involved in the evaluation process which reduced the list of 242 papers to a final choice of 31. A total of 961 reviews were made, averaging 4.2 reviews per paper.

As an appropriate climax for this effort, the proceedings will be printed from type and bound in a hard cover edition. Delivery of the published books is to be made three days before the conference opening, and there will be no increase in cost for the proceedings. The publisher is MacMillan.

Five major sessions and a panel discussion comprise the program. The sessions are entitled "Total Systems in Real Time," "Systems Simulation," "Advances in Equipment," "Communications Systems," and "Programming and Applications." The panel discussion will be concerned with "The Current Status of Programming Language Standardization."

Early last month, exhibits manager John Whitlock estimated that the 142 booth units will be oversubscribed before the end of the month. While no deadline for exhibitors was set, 58 different manufacturers of computers, systems, sub-assemblies, components and allied equipment had reserved 125 of the available units by the first week in August. Whitlock estimates over 60 firms will be represented when the conference opens.

Because the demand for exhibit space may exceed supply, the exhibits committee has discarded the customary "first-come-first-served" principle in accepting applications. As explained by Whitlock, the governing factors will be pertinence, regularity of exhibiting in prior years, and the amount of space required. Emphasis is being placed on 'live hardware.

Sponsorship of the 1961 Eastern Joint Computer Conference by the American Federation of Information Processing Societies (AFIPS) is a significant milestone. Heretofore, the semi-annual joint computer conferences have been under the aegis of the National Joint Computer Committee.

A new name for computer conferences will become effective following this year's EJCC; namely, the Spring and Fall JCC. In May, 1962, the Spring Joint Computer Conference will be scheduled for San Francisco and the 1962 Fall JCC will be held in Philadelphia.

In 1963 the Spring Conference is set for Detroit and for the Fall in Los Angeles enabling AFIPS planners to "do something about the weather" by changing Fall conferences to the West Coast and meeting in the East for the Spring Conference. ■

NEW PRODUCTS

low level multiplexer

A new low level multiplexer, the LLM-1, eliminates the need for an amplifier for each channel of information together with a high level multiplexer. The LLM-1 can switch at speeds of up to 750 channels per second and has an output range of ±10 volts with an input full scale voltage of ±10 millivolts to ±1 volt, and the noise referred to the input is less than five microvolts, with the input impedance at 1000 megohms and the d-c common mode rejection is 120 db. PACKARD BELL COMPUTER CORP., 1905 Armacost Ave., Los Angeles 25, Calif. For information:

CIRCLE 200 ON READER CARD

strain gage plotter

A multi-channel strain gage recording and plotting system with digital output, offers quick-look information and a choice of a multiplicity of digital devices as additional outputs to the standard system. Ten input conditioning modules of 10 channels each are utilized in this system, and any module can be eliminated from a data run by an on-off switch. A patch panel selects the last point, and is also used for the Flexowriter format control. B & F INSTRUMENTS, INC., 3644 N. Lawrence St., Philadelphia 40, Pa. For information:

CIRCLE 201 ON READER CARD

printer control pedestal

A new control pedestal for the series 4-1000 high speed line printer houses all of the components usually associated directly with the printer. The pedestal operates on single phase 115V± 10% 60 cycle

power and three phase 208V± 15% 60 cycle power. Power and fuse failure alarms are provided, and personnel are protected by an interlock and power system ground. ANALEX CORP., 150 Causeway Street, Boston 14, Mass. For information:

CIRCLE 202 ON READER CARD

random access system

The data disc file for the 301 is available in four standard models which range from 22 million to 88 million characters, and has been designed so that it can control two files at the same time, which allows a reduction in total access time. With two files connected to the system, the total capacity is 176 million characters, accessible in 100 milli-seconds. Each file holds from one to 24 magnetic discs, 39" in diameter, in a vertical position, and data is recorded on both sides of the disc, with each face divided into 768 recording tracks arranged in from

EAST VS. WEST

DIAGRAMS VS. EQUATIONS

THE COMPUTER'S ANSWER TO A LONG-STANDING COMPUTER ISSUE.

For a decade East Coast and West Coast computer designers have been using different methods of representing computer logic—the Easterners with diagrams, the Westerners with equations.

LBSMI =
(LXA1)(LXA2*)(LFCA*)
+(LXA1*)(LXA2)(LFCA*)
+(LXA1*)(LXA2*)(LFCA)
+(LXA1)(LXA2)(LFCA)
LFCAJ =
(LXA1)(LXA2)
LFCAK =
(LXA1*)(LXA2*)

In the example illustrated here, the diagram and the equation tell us exactly the same thing. Either represents a serial full adder where the sequence of pulses at the output, LBSM, will represent a serial binary number that is the sum of two serial binary input numbers occurring at LXA1 and LXA2. (The asterisks indicate binary complements; for example, whenever LXA1 is energized LXA1* is not, and vice versa. LFCA is a carry flip-flop.)

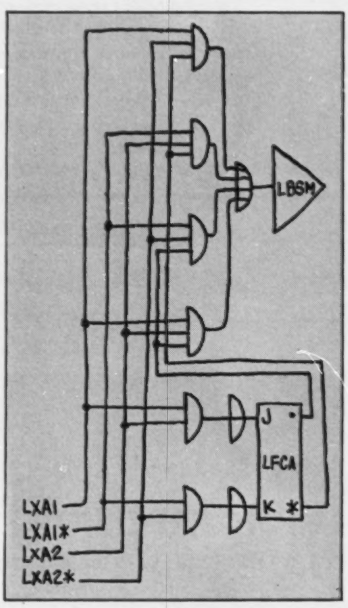
There are persuasive arguments on both sides. Eastern proponents of diagrams point out that the logical interconnections can be seen at a glance and followed through any number of stages by eye. The logical structure of an entire system can be understood from a diagram more directly and intuitively, they maintain, than from a set of equations.

The Western argument for equations goes like this. It's not true that diagrams communicate better to the viewer's intuition, except at first exposure. The human mind is highly adaptive. After working analytically with the equations for a while, the mind begins to operate intuitively in that symbology. Then the intrinsic superiority of equations over diagrams begins to make itself evident. One advantage, say the Westerners, is that equations can represent the same information more compactly and efficiently, as our illustration shows. Another is that equations lend themselves better to computer manipulation of logical design information.

As evidence of the latter advantage Westerners point to a recent achievement of some Litton Systems people: a completely mechanized procedure for translating logical designs into wiring lists, including operational simulation of the design to verify its accuracy. A procedure enormously facilitated by the computerizability of logical equations. It's easy to picture the benefits in cost, delivery schedules, reliability, price. Using only a partial development of this method Litton Systems recently brought a major computer system from concept to operation in less than a year.

Now under consideration at Litton: a machine that will accept as inputs a supply of standard computer components and a set of coded specifications defining the logical functions desired, and will crank out completely fabricated systems.

Maybe you think we've loaded the argument in favor of equations. You're right. But we're ready to listen to arguments on either side. Drop us a card. Or better still, drop in in person. You'll like the



imagination-stretching atmosphere generated by Litton management's appreciation of the rewards of creative controversy. And we have a few excellent opportunities for computer design people. Ask for S. L. Hirsch at Litton Systems, Inc., Data Systems Division, 6700 Eton Ave., Canoga Park, California.

An equal opportunity employer

LITTON SYSTEMS, INC.

A DIVISION OF LITTON INDUSTRIES

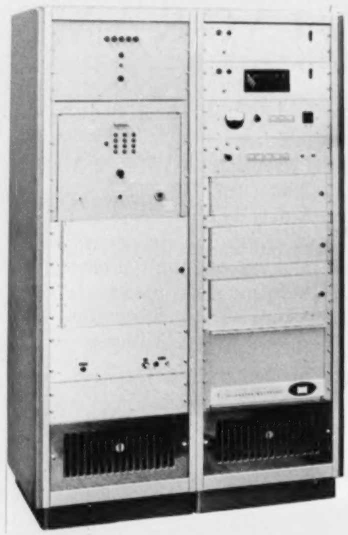
DATA HANDLING & DISPLAY SYSTEMS · GUIDANCE & CONTROL SYSTEMS · COMPUTER SYSTEMS · SPACE SCIENCE · BIOELECTRONICS · ADVANCED COMMUNICATIONS TECHNOLOGY

one to six zones for data segregation. RCA, 30 Rockefeller Plaza, New York 20, N.Y. For information:

CIRCLE 203 ON READER CARD

data conversion system

The 7320, a computer format digital data conversion system, digitizes information for direct entry into computers at rates of up to 10,000 conversions per second. Fast-moving wave forms are frozen by a sample and hold feature, so that value readout is the true value at the time the



conversion was initiated. The system has a sampling rate of 44,000 analog-to-digital conversions a second and a conversion accuracy of $\pm 0.05\%$ or one mv. MONITOR SYSTEMS, INC., Fort Washington Industrial Park, Fort Washington, Pa. For information:

CIRCLE 204 ON READER CARD

tape comparator

A complete line of tape comparator and regeneration systems duplicate and compare punched paper tapes for computer, numerical control and dp applications. Among the eight systems available is a tape-to-tape regeneration comparator, containing two motorized tape readers connected with a motorized tape punch, and a tape-to-tape regeneration comparator, with punch selector switches, allowing tapes to be verified and duplicated simultaneously. These punches and readers can be adjusted to accept 5, 6, 7, or 8 bit coded tapes in widths of 11/16″, 7/8″, or 1″. FRIDEN, INC., 97 Humboldt St., Rochester 2, N.Y. For information:

CIRCLE 205 ON READER CARD

New Products . . .

magnetic-tape certifier

The Model C magnetic tape certifier is an automatic system used for the detection of defects in tape-recording systems for data processing. The system can be used with any tape transport at its normal speed and packing density. In operation, the

tape moves until a dropout occurs. The tape can then be checked within the inspection area provided in the transport and can be rejected or advanced, depending on the cause of the drop-out. CYBETRONICS, INC., 235 High Street, Waltham 54, Mass. For information:
CIRCLE 206 ON READER CARD

ferrite core memory

The RQA is a ferrite memory having a five microsecond memory cycle with an access time of 2.0 microseconds. Standard word capacities are available in eight to 60 bit word lengths and include 1024, 2048, 4096, 8192, 16,384 and 32,768 words, AMPEX COMPUTER PRODUCTS CO., P.O. Box 329, Culver City, Calif. For information:
CIRCLE 207 ON READER CARD

magnetostrictive delay line

The magnetostrictive delay line, magline model 106, for computer use, consists of seven delay lines, each with a delay of 212 microseconds, operating at a bit rate of 300KC and having transistorized drivers and amplifiers. Also, a 3.3 microsecond recirculating delay line is used as a clock for the system and is complete with transistor circuitry. CONTROL ELECTRONICS CO., Huntington Station, Long Island, N.Y. For information:
CIRCLE 208 ON READER CARD

computer display

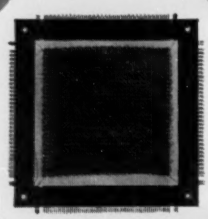
Three new systems components, the TD-549 character generator, TD-522 positioning amplifier and TD-531 digital-to-analog converter can print the output of computers on the face of a cathode ray tube at speeds higher than 100,000 characters per second, or a million words per minute. TRANSDATA, INC., P.O. Box 1369, San Diego 12, Calif. For information:
CIRCLE 209 ON READER CARD

MEETING THE COMPUTER INDUSTRY'S NEED FOR STANDARDIZED MEMORY COMPONENTS

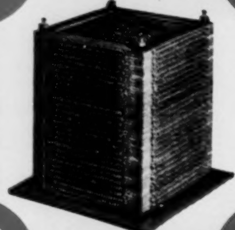
NEW FERROXCUBE 4-WIRE COINCIDENT CURRENT MEMORY PLANES AND STACKS

OFFER UNMATCHED RELIABILITY ■ COMPACTNESS ■ AVAILABILITY & ECONOMY

Many are the features that set Ferroxcube memories apart from all others; unquestionably, the most noteworthy is **reliability.** All array terminal connections are multiple wire wrapped and dip soldered to eliminate the fallibility of hand soldering. All memory cores are 100% precision tested on all electrical parameters both before and after assembly in the matrix. **Compactness** of design—achieved by wafer construction and by wiring memory cores on 50 mil centers—makes for substantial reductions in stack dimensions. **Availability** is continuously assured by Ferroxcube's unmatched manufacturing capabilities. **Economy** follows as a result of Ferroxcube's high volume production, highly adaptable frame construction and the elimination of costly hand soldering. For complete information write for Bulletin PS-161.



64 x 64, 4-WIRE, COINCIDENT CURRENT MEMORY PLANE.



COMPACTNESS OF MATRIX REDUCES STACK DIMENSIONS.

FOREMOST IN THE FIELD OF FERRITE

FERROXCUBE CORPORATION OF AMERICA ■ SAUGERTIES, N.Y.

CIRCLE 31 ON READER CARD

DATAMATION

NEW LITERATURE

REAL-TIME SYSTEM: Design approach to a typical real-time updating and transaction processing system, configuration, operation, optional features and advantages are outlined in this eight-page brochure. Further information includes assignment, scope, system criteria and background. STONE LABORATORIES, INC., 1312 Tremont St., Boston 20, Mass. For copy:

CIRCLE 260 ON READER CARD

EUROPEAN DP: A 19-page booklet surveys computer developments in Europe, describes several of the most promising technical developments and summarizes the characteristics of most of the computers in operation and in development. Also included is a table of definitions of European computer terminology. AUERBACH ELECTRONICS CORP., 1634 Arch Street, Philadelphia 3, Pa. For copy:

CIRCLE 261 ON READER CARD

INTERROGATOR SYSTEMS: A new brochure includes descriptions and photographs of alphanumeric and numeric interrogators, a newly developed keyboard and display device that permits transmission of data to and from remote EDP files and computers. Features of several models including the 2501 and 2502, are listed. INFORMATION PRODUCTS CORP., 156 6th St., Cambridge, Mass. For copy:

CIRCLE 262 ON READER CARD

DIGITAL INSTRUMENTATION LINE: A description of high speed solid state and vacuum tube electronic counters, timers, preset counter-controllers, decade counting units, readouts, printers and frequency measuring instrumentation is offered in this 20-page catalog. Charts, illustrations, prices and representative locations are included. COMPUTER MEASUREMENTS CO., 12970 Bradley Ave., San Fernando, Calif. For copy:

CIRCLE 263 ON READER CARD

2400 DATA HANDLING SYSTEM: A color brochure on the 2400 data handling system details such features as the handling of variable lengths of I/O data, manipulation of data character-by-character and bit-by-bit for editing and code translating, and reduction of hardware requirements. Also included is a system description, and information regarding data preparation, auxiliary processing, expanded processing, traffic control and computer scheduling, programming and system reliability. PHILCO CORP., COMPUTER DIV., 3900 Welsh Rd., Willow Grove, Pa. For copy:

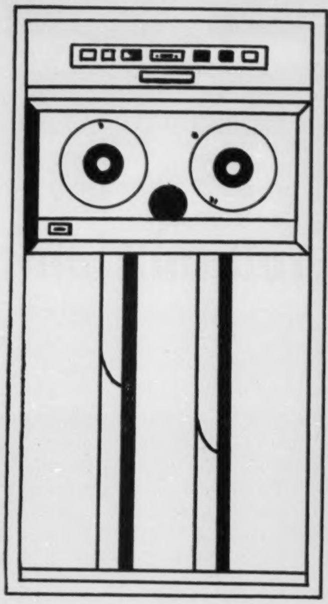
CIRCLE 264 ON READER CARD

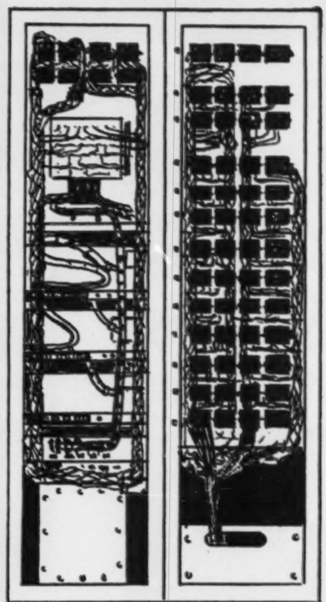
PROJECT CONTROL METHODS: Technical bulletin #103 illustrates Project Control Methods, a computer service that employs Project Evaluation and Review Technique (PERT), and Critical Path Scheduling. Advantages, pricing, and the four types of available reports from the PERT program are described. THE SERVICE BUREAU CORP., 425 Park Ave., New York 22, N. Y. For copy:

CIRCLE 265 ON READER CARD

FIRE PROTECTION STANDARD: A booklet provides recommendations for controlling fire problems in the installation and operation of computer systems and covers fire protection feattures in buildings and rooms housing computers. Send 50¢ to: NATIONAL FIRE PROTECTION ASSOC., 60 Batterymarch St., Boston 10, Mass.

TRANSISTORIZED LOGIC MODULES: An illustrated series of leaflets on transistorized logic modules details the active element, computer gate card, clock pulse amplifier, digital gate, dual medium speed flip-flop, nixie driver, clock oscillator, blocking oscillator, delay multivibrator, high-speed flip-flop, magnetostrictive delay line driver and amplifier, analog multiplexer gate, summing amplifier, servo





NEW LITERATURE . . .

amplifier, two leg digital gate. Diagrams, characteristics and power requirements are included. GENERAL APPLIED SCIENCE LABORATORIES, INC., Merrick and Stewart Ave., Westbury, N. Y. For copy:

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NUMERICAL CONTROL: A 32-page, illustrated booklet presents information about the machine tool, numerical control field and includes a definition of the subject with an explanation of the use of punched tape in machine tool applications. Other topics include standardizing punched tapes, standardized programming, programming tapes and fields in which numerical control may be used. FRIDEN, INC., 97 Humboldt St., Rochester 2, N. Y. For copy:

CIRCLE 267 ON READER CARD

COMPUTER ABSTRACTS ON CARDS: A 29-page booklet describes a new service called *Computer Abstracts on Cards,* designed to reduce literature search time in the dp field. The booklet highlights the classification system, form and content, filing and use of this file. Also included is an abridged outline or pre-index of subjects. CAMBRIDGE COMMUNICATIONS CORP., 238 Main Street, Cambridge 42, Mass. For copy:

CIRCLE 268 ON READER CARD

LINEAR PROGRAMMING SYSTEM: A four-page color brochure highlights features of the 2000 linear programming system which include backward reading, the storage of 2,500,000 words on a reel of magnetic tape with various arithmetic formats and a reading and writing rate of 90,000 alphanumeric characters or 157,500 decimal digits per second. Functions which tape-stored macro-instructions can perform are listed. PHILCO CORP., COMPUTER DIVISION, 3900 Welsh Rd., Willow Grove, Pa. For copy:

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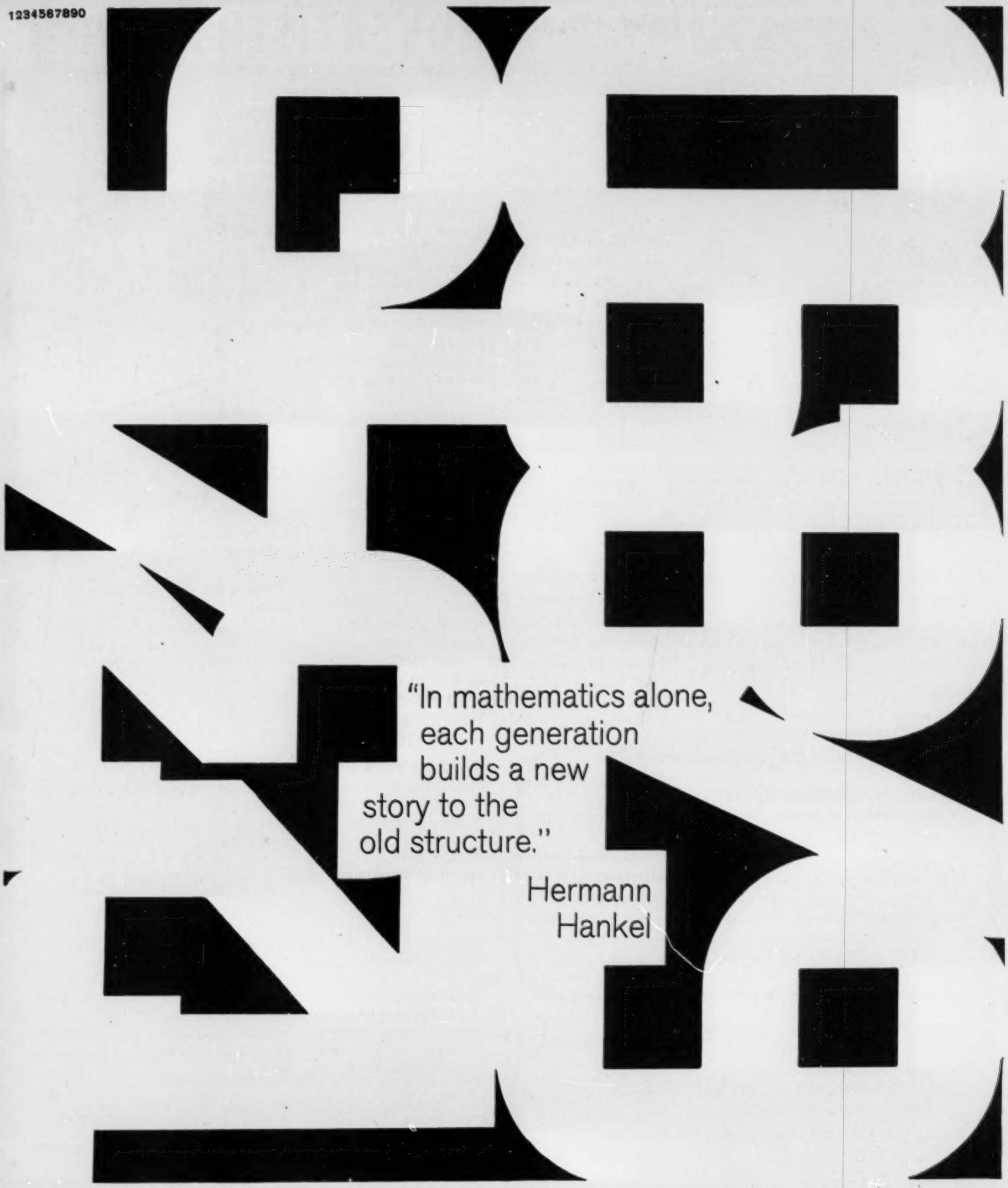
PRODUCT LINE: This illustrated brochure presents various systems used in the fields of IR, integrated DP, automatic writing and visible card filing. These include the needle/sort marginally punched card systems, peek-a-data IR system, complex manifold sets, hecto master-patch card addressing system, and data-tab filing system. BERKLEY CORP., DATA SYSTEMS DIVISION, West Hartford, Conn. For copy:

CIRCLE 270 ON READER CARD



IBM mathematicians and programmers are doing work today that will still have meaning years from now.

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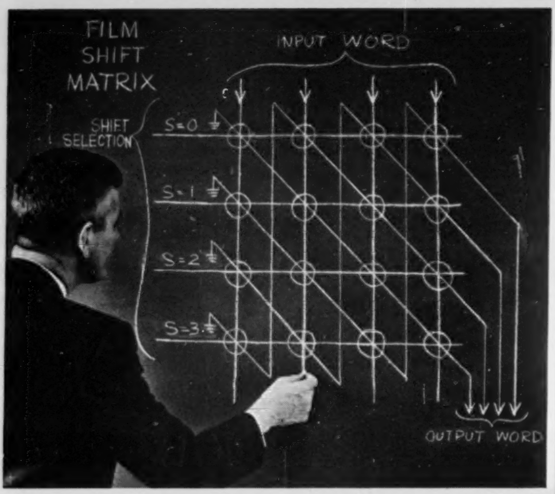

This logic array has been developed in the Remington Rand Univac Mathematics and Logic Research Department. In simplified form, each circle represents a film element that AND's the bits from the horizontal and vertical lines to produce an output on the diagonal line. The input word is therefore left-circular shifted **S** places in passing to the output. Such matrixes can produce arbitrary right or left shifts, either circular or open-ended, in a single clock period for full length computer words. Film logic arrays open a new field of high speed, high density logic devices.

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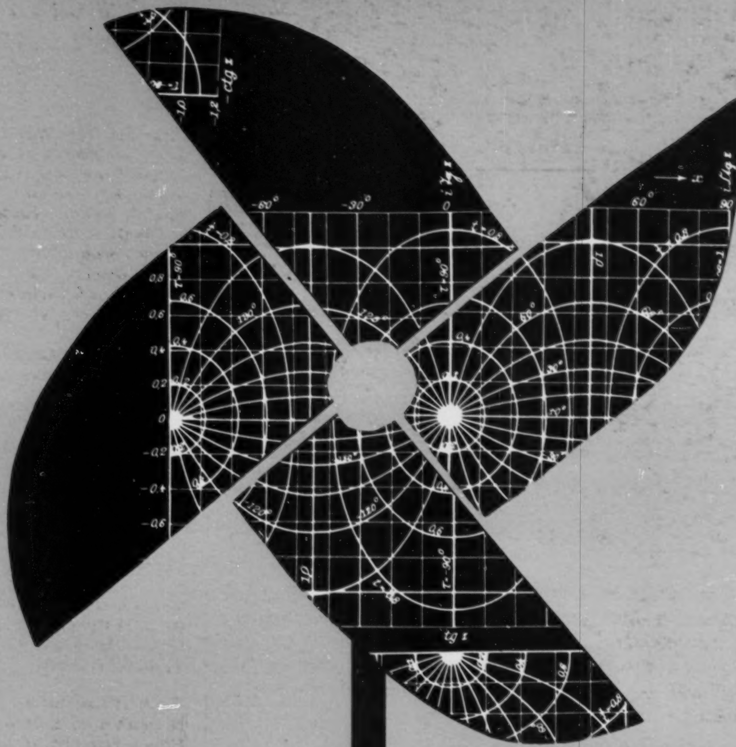
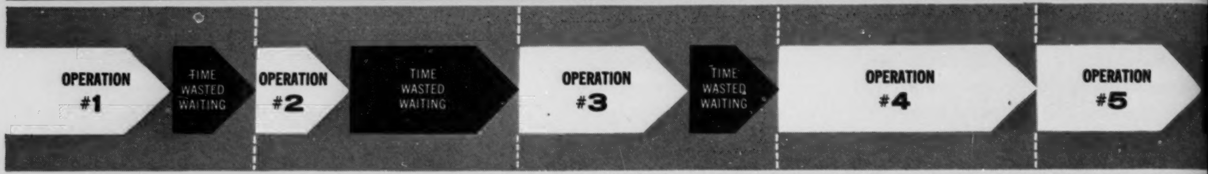
How to d, b, s big machine



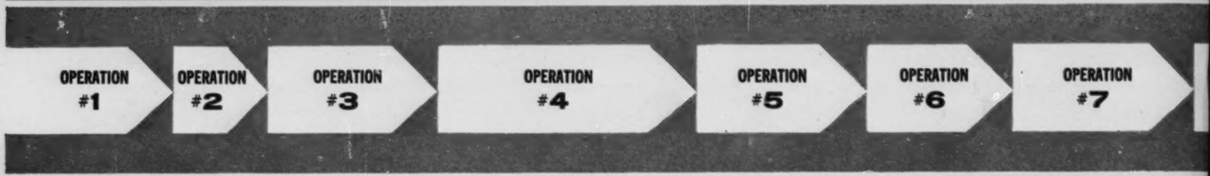
Your Computer is Wasting Time and Money!

[unless it's asynchronous]



SYNCHRONOUS

Synchronous computers waste time waiting!



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Save money with the Philco 2000 Series

In other computers the master clock breaks time into cycles tailored to the longest operation. Shorter operations are also completed within these same time limits. Time is wasted . . . *waiting*.

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Let us tell you more about asynchronous operation and the Philco 2000 Series, the only asynchronous computers. Write today.

HOW MUCH TIME DO THE PHILCO 2000 SERIES COMPUTERS SAVE? COMPARE:

Typical processing rate: 639,000 additions per second, including access time.

Access time: 0.5 microsecond.

Multiple processing capability: up to seven instructions simultaneously through four-way processing. Multiplies time saving by four.

Typical problem: Invert a 100 x 100 matrix.

Computation load: 1 million multiplications and 1 million additions.

Time: only 6 seconds!

CIRCLE 3 ON READER CARD

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